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*MIMICRY IN INSECTS.**

SHARING in the perplexity avowedly felt by many of my predecessors in this chair as to the choice of a subject for the annual address—perplexity arising rather from the redundancy than from the scarcity of entomological matter—I have been led to think, considering the wide-reaching importance of the questions involved and the unmistakable interest shown in the recent discussion at two of our meetings, that some account of the mimetic relations existing among insects might not be out of place. Having for a considerable period devoted some attention to the matter, I propose to pass in review what has been placed on record; and if, in so doing, I traverse ground very familiar to most of us, my excuse must be the fascinating interest which attaches to the whole subject.

The application, by Henry Walter Bates, our lamented President, of the great principle of natural selection in elucidation of the mimicries found among insects† is too well known to require any detailed repetition here. It is sufficient to recall that, as the result of many years' experience in tropical South America, Bates established the facts that (1) among the abundant and conspicuous butterflies of the groups Da-

* Address of the President, Mr. Roland Trimen, F.R.S., before the Entomological Society of London, 1898.

† Trans. Linn. Soc., XXIII. (1862).

nainæ, Heliconiinæ, Acræinæ, and some Papilioninæ were found very much rarer mimicking forms, chiefly of the group Pierinæ, but partly belonging to other groups, and some even to the Heterocera, which, departing very widely from the aspect of their respective allies, imitated with more or less exactness the abundant species in question; (2) the numerous and showy Danainæ, etc., although of slow flight, did not appear to be molested by the usual insectivorous foes; and (3) the members of these unassailed tribes possessed malodorous juices not found in the mimicking forms or their allies. From these data he argued that the examination of these extraordinary resemblances was to be found in the great advantage it would be to species undefended by offensive secretions, and therefore palatable and much hunted down, to find escape in the disguise of species recognized and avoided as unpalatable; and traced the mimicries to the long-continued action of natural selection, perpetually weeding out by insectivorous agencies every occurring variation not in the direction of likeness to the protected forms, but as perpetually preserving, and so aiding the development by heredity, of every variation favorable to the attainment of the protective mimicry.

This sagacious application of the Darwinian theory in solution of one of the most difficult and baffling of the problems presented to zoologists was of the greatest service and encouragement to all students of evolution. I retain to-day the liveliest recollection of the delight I experienced in the perusal of a copy of Bates's Memoir received from himself; for his work was not that of the mere cabinet systematist, but came with all the force of face-to-face commune with the abounding life of the tropics.

Before two years had passed, Bates's explanation of mimicry was confirmed by his former companion in exploration, Alfred Russel Wallace, who, working with equal devotion in the Malayan Islands, had observed and was able to adduce a strictly analogous series of mimetic resemblances among Oriental butterflies, and gave his unreserved acceptance of the Batesian interpretation.* Such support from the cofounder with Darwin of the theory of natural selection, and from a naturalist of the widest experience in both Western and Eastern tropics, was of the greatest weight with evolutionists generally.

My own contribution to the subject was read to the Linnæan Society in March, 1868.† In the previous year I had made an entomological tour in Natal, and had enjoyed some precious opportunities of observing in nature several cases of mimicry between species not inhabiting the Cape Colony. There was no claim to originality in my paper; it simply rounded off the case by adding from Africa, the third great tropical region of the globe, a series of instances and observed facts confirmatory of those brought forward by Bates from the Neotropical, and by Wallace from the Oriental region. Of course, I had nothing like the extended field experiences of those great naturalists, and the African material then available was but scanty; but it so happened that perhaps the most striking and elaborate of all recorded cases of mimicry—that exhibited by the females of the *Merope* group of *Papilio*—had come under my personal observation in South Africa, and I was thus in a position to describe satisfactorily a wonderful illustration of the Batesian theory.‡

* Trans. Linn. Soc., XXV. (1864).

† Tran. Linn. Soc., XXVI. (1869).

‡ At various subsequent dates I was enabled, through the valuable aid of Mr. J. P. Mansel Weale and Colonel J. H. Bowker, to make known to science conclusive evidence of the species-identity of the three mimetic females of *Papilio cenea*, and of the pairing of the widely-differing sexes of that species. See Trans. Ent. Soc. Lond., 1874, p. 137, and 1881, p. 169; and 'South African Butterflies,' III., p. 254 (1889).

It will be remembered that Bates, in his memorable paper (*l. c.* p. 507), also brought to notice the very close resemblances, or apparent mimicries, which unquestionably exist between species belonging to different groups or subfamilies of protected distasteful butterflies themselves; but neither he nor Wallace felt able to give any explanation of these instances, which obviously differed very materially from the cases of mimicry of an unpalatable protected species by a palatable unprotected one. Not until 1879 was there any elucidation of this side of the matter, but in May of that year appeared in 'Kosmos,' Fritz Müller's notable paper on '*Ituna* and *Thyridia*,' which was translated by Professor Meldola, and printed in our 'Proceedings' for the same year (p. xx.). In this memoir Müller made the valuable suggestion that the advantage derivable from these resemblances between protected forms was the division between two species of the percentage of victims to the inexperience of young insectivorous enemies which every separate species, however well protected by distastefulness, must pay.

Professor Meldola not only brought forward and supported, with all his wonted grasp and acumen, F. Müller's daring interpretation of this phenomenon, but in 1882,* in a paper discussing the objections brought against Müller's view, made a distinct advance by showing how that view could justly be extended to explain the characteristic and peculiar prevalence of one type of coloring and marking throughout numbers of species in protected groups—so especially noticeable in the subfamilies Danainæ, Heliconiinæ and Acræinæ.

In 1887 was published† Professor Poulton's most interesting memoir entitled 'The Experimental Proof of the Protective Value of Colors and Markings in Insects in reference to their Vertebrate Enemies,' which dealt in great detail with the actual results of numerous experiments conducted by himself and other naturalists with the object of ascertaining to what extent highly conspicuous (almost always distasteful) larvæ and perfect insects are rejected or eaten by birds, lizards and frogs. The conclusions given at the close of this paper (pp. 266–267) cover a wide range in connection with the subject of warning coloration, and among them I would call special attention to No. 5, in which the author points out that "In the various species in which a conspicuous appearance is produced by color and marking, the same colors and patterns appear again and again repeated," and adds that "In this way the vertebrate enemies are only compelled to learn a few types of appearance, and the types themselves are of a kind which such enemies most easily learn." This generalization certainly had the merit of first detecting a great additional advantage derivable from the common aspect exhibited by a number of protected forms in the extended 'Müllerian' associations indicated by Professor Meldola; and it was applied by Wallace to the case of the Heliconiidæ in the comprehensive survey of warning coloration and mimicry generally given in 'Darwinism' (Ch. IX., pp. 232–267, 1889). We are further indebted to Professor Poulton for the discussion and summary of all extant data up to 1890 in his 'Colors of Animals,' a work which abounds in pregnant suggestion and indicates with justice and clearness how far the evidence forthcoming was valid and in what directions evidence still lacking should be sought.

Wallace well observed ('Darwinism,' p. 264) that "to set forth adequately the varied and surprising facts of mimicry would need a large and copiously illustrated volume; and no more interesting subject could be taken up by a naturalist who has

* Ann. and Mag. Nat. Hist. (5), X., pp. 417–425.
† Proc. Zool. Soc. Lond., 1887, pp. 191–274.

access to our great collections and can devote the necessary time to search out the many examples of mimicry that lie hidden in our museums." A work ostensibly of this character was issued in 1892–93, in two parts, from the pen of the late Dr. Erich Haase, under the title of 'Untersuchungen über die Mimicry auf Grundlage eines natürlichen Systems der Papilioniden;'* and last year an English translation of the second part was published and has quite recently been reviewed by Professor Poulton.† This treatise is of large quarto size, and the first part contains 120 pages and 6 colored plates, while the second extends to 158 pages and includes 8 colored plates. The first part‡ deals solely with the family Papilionidæ (*s. str.* = subfamily Papilioninæ) and principally with the great genus *Papilio* (*s. lat.*), which, on grounds of structure, system of markings, form of larvæ and pupæ and food-plants of larvæ, is divided into the three subgenera of *Pharmacophagus*, *Cosmodesmus* and *Papilio* (*s. str.*). With the utmost minuteness the species assigned to these groups, with their sexual, geographical or mimetic variations, are traced through the four zoological regions recognized by the author, and very elaborate analysis of markings is made in aid of arriving at their natural affinities from a phylogenetic point of view. Haase shows that in *Papilio* the models which are mimicked by other species of that great genus are always members of the *Pharmacophagus* group, or, as he calls them, 'Aristolochia-Butterflies'—whose larvæ feed on that tribe of plants, and which, as he contends, derive their offensive juices directly from the poisonous properties of their food in the early state.

In Part 2§ a lengthy account is given of the cases of mimicry occurring throughout the class of insects, and reference is also made to the few known instances in other classes of animals. The Lepidoptera occupy the bulk of the memoir, and, as in Part 1, a geographical order is followed, the mimicries in each of the four zoological regions being given under each of their respective families and genera, but in separated accounts of (firstly) models and (secondly) mimickers. In the 'Allgemeiner Theil,' which concludes the work and occupies about half of Part 2, there are sections treating of mimicry (*a*) within the limits of the old genus *Papilio* (in connection with Part 1), (*b*) between 'immune' and non-immune' Lepidoptera, and (*c*) among 'immune' Lepidoptera themselves; followed by a consideration of objections to the theory of mimicry, and of mimicry as a part of protective adaptation to the environment.

While I regard Part 1 as a memoir of value, and as likely to prove serviceable to the student of a group so difficult to classify as the Papilioninæ, and while I recognize the great labor and research displayed throughout the work in the assembling of the accessible facts and data, I must reluctantly record my concurrence in Professor Poulton's severe criticism of the extremely unsatisfactory nature of the general treatment of the subject in Part 2. Apart from the cumbrous handling of the mass of details accumulated, the writer manifests such disregard of obvious difficulties, such unscientific haste in jumping at conclusions, and such inadequate recognition of what had been accomplished by previous investigators, that one can only regret that he ever entered on the speculative part of his work, and did not confine his energies to the better concentration and arrangement of the materials so assiduously collected.

Among recent contributions to the subject we shall, I think, all agree in assigning

* In Vol. III. of *Bibliotheca Zoologica* (Stuttgart).
† *Nature*, 4th and 11th November, 1897.
‡ *Entwurf eines natürlichen Systems der Papilioniden.*
§ Subtitle, 'Untersuchungen über die Mimicry.'

a high place to the memoirs with which Dr. F. A. Dixey has enriched our 'Transactions.' In 1894 he read before the Society his elaborate paper 'On the Phylogeny of the Pierinæ as illustrated by their Wing-markings and Geographical Distribution,' and took occasion to discuss the wide divergence from the primitive or typical pattern of the group caused by mimicry in such genera as *Euterpe, Pereute, Dismorphia*, etc. Adopting the Müllerian interpretation as expanded by Meldola, he proceeded to offer the original suggestion that, in the acquisition of closer resemblance between two or more protected forms, it was not necessary that in every instance the process of adaptation should lie solely in the imitation of one particular form as model, but that there might very well exist *mutual* convergence of the forms concerned, thus accelerating the attainment of the common beneficial resemblance. This 'reciprocal mimicry' the author further explained in a paper read in 1896 'On the Relation of Mimetic Patterns to the Original Form' (pp. 72–75), by a consideration of certain mimetic sets of Heliconii, Pierinæ and Papilioninæ, which present features and relations of pattern and coloring explicable apparently in no other way than by the hypothesis in question. This paper also gave a lucid demonstration, traced through corresponding series of existing forms of both mimetic and non-mimetic Pierinæ, of "the successive steps through which a complicated and practically perfect mimetic pattern could be evolved in simple and easy stages from a form presenting merely the ordinary aspect of its own genus," and further adduced reasons for holding that "it is not necessary that the forms between which mimicry originates should possess considerable initial resemblance." In his latest memoir, 'Mimetic Attraction,' read on May 5th last,* Dr. Dixey expanded a suggestion that he had previously (1896) made respecting divergent members of an inedible group, to point out—still from evidence in the Pierine subfamily to which he has devoted so much fruitful study—"how the process of gradual assimilation starting from one given point may take not one direction only, but several divergent paths at the same time," with the result that a more or less intimate mimetic relation was brought about with several protected forms of quite different affinities, though each connected in their coloring and aspect with some group of distasteful associates. He further set forth very fully the distinction which exists between the mimicry of inedible by edible forms, which could only be in one direction and was of advantage to the mimicker alone, and the assimilation among inedible forms themselves, where the mimetic attraction acts reciprocally, to the advantage of all participators.

Another of our Fellows, Colonel C. Swinhoe, distinguished for his wide and intimate knowledge of Oriental Lepidoptera, read before the Linnæan Society, in 1895, a most interesting paper 'On Mimicry in Butterflies of the genus *Hypolimnas*.'* In this memoir, as the author points out, a small group of wide-ranging mimetic insects is followed throughout its geographical distribution; and the process of mimetic modification is traced through the female, from the amazing instability of that sex of *H. bolina* (local form) in the Fiji Islands, where the male is stable and of the normal ancestral pattern and coloring, to the opposite extreme in Africa, where (with the exception of *H. misippus*) both sexes of the known allied forms of the genus are equally mimetic.† The singular contrast between

*Trans. Ent. Soc., Lond., 1897, p. 317.

* Linn. Soc. Journ. Zool., XXV., pp. 339–348.

† It should be noted that in the African *H. salmacis* and the Malagasy *H. dexithea* the sexes are alike and non-mimetic, and that therefore these species probably most closely approximate to the primitive appearance of the genus.

the numerous modifications of the female of the *Bolina* type, and the absolutely constant imitation of *Danais chrysippus* alone by the ♀ *H. misippus* is well brought out, and the different courses thus pursued by the respective females are shown to depend on the range, variation and abundance of the model that is mimicked. Colonel Swinhoe had previously (1887) published a good account of mimicry in Indian butterflies,* and in it made special reference to the remarkable series of close likenesses between species belonging to different subgenera of the great protected genus *Euplœa*.

So much prominence has naturally been given to the very conspicuous development of mimicry among the Lepidoptera that it is not uncommon to hear the matter spoken of as if limited to butterflies and moths, and even entomologists need to be reminded of the prevalence of the phenomenon among other orders of insects. The stinging Hymenoptera furnish the most numerous models to members of other orders, being closely mimicked by numerous Diptera, by many heterocerous Lepidoptera, by various Carabid, Heteromerous and Longicorn Coleoptera, and by some Hemiptera; while certain ants are well imitated by spiders. As regards Coleoptera mimicry is mainly found within the limits of the order itself—*e. g.*, Cicindelids by Heteromera and Longicorns, Carabids by Heteromera, Malacoderms by Longicorns, and Rhynchophora by Longicorns; but certain Cicindelid and Rhynchophorous beetles are closely copied by Orthoptera, belonging respectively to the genera *Condylodeira* and *Scepastus*. Lepidoptera do not seem to find mimickers beyond their own order, unless the case quoted by Haase† from E. Hartert, of the resemblance of a large Cicada to the Indian *Thaumantis aliris* (Morphinæ) be one of actual mimicry. Nor do Diptera appear to be models for imitation, except in the case of the hunting spiders, which mimick the Muscidæ they chase; although the neuropterous *Bittacus* certainly bears a strong likeness to Tipula, and may possibly find the advantage of that harmless aspect in approaching its prey. It cannot be denied that some of the interordinal mimicries are even more impressive and striking than those so notable among butterflies, the excellence of the superficial disguise of general outline, proportion of parts, coloring and markings being so great as to throw into obscurity the really vast structural discrepancies. Such cases as the imitation of the South American wasps of the genera *Polybia* and *Synœca* by moths of the genera *Sphecosoma* and *Myrmecopsis*,* of the Bornean sand-wasp *Mygnimia aviculus*, by the beetle *Coloborrhombus fasciatipennis*,† or of the Philippine tiger-beetle *Tricondyla* by the cricket *Condylodeira*, ‡ are absolute marvels of deception, all belonging to that special phase of mimicry where the obvious advantage to the unarmed mimic lies in being mistaken for the armed and formidable model.

As the Lepidoptera are at present the only order in which a very considerable number of mimetic relations have been observed, it may be of service to note here the various directions in which mimicry ramifies within the ordinal limits. The very large majority consists of cases where (*a*) Rhopalocera are copied by other Rhopalocera; and, taking the groups in succession, we find that (1) Danainæ (including Neotro-

* Journ. Bombay Nat. Hist. Soc., II., pp. 169–174.

† *Op. cit.*, II., p. 10. Haase (on p. 11) cites Brauer to the effect that the genus *Drepana* is mimicked by the neuropterous *Drepanopteryx*, which is stated to eed on Lepidoptera.

* See Haase, *l. c.*, II., p. 76, Pl. XIII.

† See Pryer, Trans. Ent. Soc., 1885, p. 369, Pl. X., who in the same place also figures another most striking case from Borneo, in which the hymenopterous *Triscolia patricialis* is mimicked by the lepidopterous *Scoliomima insignis*.

‡ See Bates, *l. c.*, p. 509.

pinæ) are mimicked by members of their own subfamily, by Satyrinæ, Heliconiinæ, Nymphalinæ, Erycinidæ, Pierinæ and Papilioninæ; (2) a few Morphinæ by Papilioninæ; (3) Heliconiinæ by Pierinæ; (4) Acræinæ by Nymphalinæ, Lycænidæ, Pierinæ, and Papilioninæ; (5) some Nymphalinæ, by members of their own subfamily; (6) Pierinæ by species of their own subfamily, and very rarely by Satyrinæ;* and (7) Papilioninæ by members of their own subfamily and by certain Pierinæ.

The next series is composed of those comparatively few instances where (*b*) Rhopalocera are imitated by Heterocera; and here it is found that (1) Danainæ (true, and Neotropinæ) are mimicked by Castniidæ, Chalcosiidæ (three different genera); Arctiidæ (two different genera), Dioptidæ (three different genera), and Geometræ (two different genera); (2) a few Acræinæ by Melameridæ (two different genera); (3) Papilioninæ by Castniidæ, Chalcosiidæ, and Arctiidæ. † Much rarer are the known cases of (*c*) mimicry of Heterocera by Rhopalocera; but (1) certain Uraniidæ are simulated by Papilioninæ; (2) Agaristidæ by Nymphalinæ; and (3) Lithosiidæ by Nymphalinæ. The mimicry of (*d*) Heterocera by Heterocera seems also to have been but seldom observed, but the cases recorded consist of (1) Agaristidæ by Liparidæ; (2) Melameridæ by Chalcosiidæ; (3) Geometridæ by Uraniidæ and Chalcosiidæ, and (4) Lithosiidæ by Agaristidæ.*

It will be seen that the foregoing enumeration includes not only the Batesian mimicries, but also those coming under the category of Müllerian associations of distasteful forms. To the latter class belong all cases occurring within the limits of the subfamilies Danainæ, Heliconiinæ and Acræinæ, and also many of those existing between species of one or more of those groups and certain Pierinæ and Papilioninæ, as well as (among moths) the Agaristidæ, some Lithosiidæ, and very probably others. It seems clear that, in the same circle of various species all approximating with more or less accuracy to one special type of coloration, marking and outline, there will often be found, in the larger and more comprehensive of such associations, both Batesian and Müllerian mimicries; this is, indeed, distinctly to be gathered from some of the cases tabulated by Bates himself, and has been lately well illustrated in the exceptionally rich Neotropical series of 'homœochromatic' forms brought before us by Mr. W. F. H. Blandford, among which were several of the actual specimens figured by Bates in illustrating his famous memoir. In the scarcely less opulent

* In the Oriental region *Delias* is mimicked by *Prioneris* and *Pieris*, and in the Ethiopian region *Mylothris* by *Pieris* and *Eronia*. An interesting case in support of the probable distastefulness of *Mylothris* is found in Madagascar, where the abundant *M. phileris* is mimicked by the very scarce *Elymnias masoura*, a Satyrine which is extremely divergent in coloring from all known members of its genus and subfamily.

† Col. Swinhoe informs me that the Pierine *Teracolus limbatus*—'the southern form of *T. etrida*'—is accurately mimicked by the Geometrid moth, *Abraxas etridoides*. This case seems to support Col. Swinhoe's opinion (Proc. Ent. Soc. Lond., 1897, p. xxxvii.) that the species of *Teracolus* are inedible. I have noted (Proc. Zool. Soc. Lond., 1894, p. 21) another instance of marked resemblance to the females of the smaller East African *Teracoli* in the Satyrine, *Physcæneura pione*.

* There is some ground for suspecting *Acherontia atropos* to be a protected species. It has an apparent mimicker in Africa—its natural habitat—in the shape of another Sphingid of almost equal size, *Protoparce solani*, which, when seen at rest on tree trunks, I have, on more than one occasion, mistaken for the Death's Head. I do not know if any experiments as to the distastefulness of *Acherontia* have been made; but I incline to the belief that, if this moth is shunned by any insectivorous animals, such avoidance is more likely to be due to its squeaking powers and its threatening gesture, when irritated or alarmed, of suddenly elevating the robust and spiny fore legs. I know of no other moth that assumes this menacing attitude.

Oriental region (as Col. Swinhoe has pointed out in the paper above mentioned, and has more fully of late described to me) the same state of things is prevalent, extensive Müllerian inedible associations among (*e. g.*) the species of the three main groups into which the old genus *Euplœa* has been divided, being 'attended and surrounded' by numerous true mimics belonging to edible groups. The far poorer Ethiopian region has, to my knowledge, yielded as yet only a few series including both inedible and edible imitators; but in the group of which the Danaine *Amauris egialea* is the center there appears the exactly similar *Danais* (*Melinda*) *morgeni;* and in the same way the much-mimicked *Amauris echeria*, var., has in East Africa a protected companion in the female *Acræa johnstoni*, while there is some reason for thinking that the widely-distributed *Acræa encedon* is modified in resemblance to the dominant *Danais chrysippus*. Perhaps the most remarkable of these associations is that which surrounds the abundant and extremely conspicuous slow-flying diurnal Lithosiid moth, *Aletis helcita*. The apparently protected analogues of this insect are the closely similar Lithosiid *Phœagarista helcitoides* and Agaristid *Eusemia falkensteinii*, while the Batesian mimickers are found in the Nymphaline butterflies, *Euphœdra ruspina* and *E. eleus*, and the aberrant Lycœnid, *Liptena sanguinea*. Another point of interest in this last-named series is its great similarity in coloring and marking to that which is headed by *Danais chrysippus*, the differences being merely that in the *Aletis* set the red ground-color is brighter and the white spots in the black margins are larger; so that from the aspect of warning of distastefulness to enemies the two sets may be regarded as practically but one.

Among the Batesian mimicries in the Ethiopian region, I wish to revert more fully to the very striking and instructive case, already briefly referred to, presented by the females of the *Merope* group of the genus *Papilio*, because it has largely gained in interest by the increase of our knowledge in recent years. In 1867, when I wrote the paper above mentioned,* only three forms of the *Merope* group were known, *vid.:* the West African *P. merope*, the South African *P. cenea* (then regarded as not more than a variety of *P. merope*), and the Madagascar *P. meriones*. Of these the last-named alone had the sexes nearly alike, *vid.:* of a very pale yellow, margined with black in the forewings, and with the hind wings more or less black-marked and bearing conspicuous tails; each of the two continental species presenting not only the utmost disparity between the sexes, but also the singular phenomenon of a polymorphic female, invariably without tails, accurately mimicking two or three widely-differing species of Danainæ, and at the same time offering numerous linking variations. I was justified in considering that the Madagascar form should be regarded as retaining the ancestral condition of this group of *Papilio*, while the females of the continental forms had been profoundly modified in the mimetic directions specified; and I pointed to the costal black bar in the fore wings of the female *P. meriones* as possibly indicating the feature on which natural selection had been able to work, to the ultimate production of close imitation first of the lighter and at length of the darker Danainæ concerned.

It was startling to learn, in 1883, that a newly-discovered continental form of the group, *P. antinorii*, inhabiting Abyssinia, like the Madagascar *P. meriones*, had the sexes quite alike, except for the costal black bar in the female; while in 1889 there was described from the Comoro Islands a fifth and very distinct species, *P. humblodi*,

* Trans. Linn. Soc., XXVI.

in which the sexes resemble each other even more closely than in the Madagascar form, and which, therefore, in all probability exhibits a still more primitive condition.

The survival of the ancestral similarity of the sexes on the African mainland, so far from the Malagasy archipelago as Abyssinia, was a discovery of much importance; and the greatest interest was added to the whole case when, in 1890, Professor N. M. Kheil,* of Prague, described and figured two most remarkable new forms of the female *P. antinorii*. These females, given by the author as 'ab. *niavioides*' and 'ab. *ruspinæ*,' respectively, in coloring and pattern mimic *Amauris dominicanus* and *Danais chrysippus*, almost as closely as do the *hippocoonoides* and *trophonius* females of *P. cenea*, but yet retain on the hind wings the fully-developed tails possessed by the male and the unmodified female.† One would naturally suppose that these conspicuous appendages to the hind wings, never found in the Danaidæ, but so characteristic of many groups of *Papilio*, would have been among the first features to be lost in the process of assimilation to the Danaine models; and, as Professor Kheil mentioned in his paper, that the tails of the specimens of '*niavioides*' were injured, but had been restored in the figure, I felt a little doubtful about them, and ventured recently to address him on the subject. He most obligingly answered my inquiries, stating that the two forms of female were still in his possession, and that while the tails of the ab. *niavioides* were injured, as originally pointed out, those of the ab. *ruspinæ* were intact and are correctly delineated in Haase's figure, which—as well as that of *niavioides*—was drawn from the actual specimens, lent by Professor Kheil. It is to be noted that the tails are uniformly black, in accord with the broad hind margins, instead of being pale yellow with a short median streak of black, as in the female of the male coloration. Professor Kheil further informed me that the discoverer of these forms, the late Dr. A. Stecker, who collected at Lake Tana, brought together seven males, two females like the male, and one only of each mimetic form of female, and that he reported the male as very common, while the females seldom occurred.

This persistence in Abyssinia of the original female *P. antinorii*, side by side with two mimetic forms of the same sex retaining her outline of hind wings, but far divergent from her in advanced imitation of two very different Danainæ belonging to distinct genera, is strong confirmatory evidence of the view I advanced as to the development of the various tail-less mimetic African females of the group from the ordinary male-like type of female solely prevalent still in the Malagasy sub-region. From analogy with what occurs over so large an area of the rest of Africa, I confidently anticipate that we shall receive from Abyssinia intermediate gradations between the three known forms of the female *P. antinorii*; and as the dominant model, *Amauris echeria*, is represented in Abyssinia by the abundant and very closely allied *A. steckeri*, I should not be surprised to see another mimetic female of *P. antinorii* closely resembling the typical *P. cenea*. More than this, we may not unreasonably hope to discover, at some point in the wide territories between Abyssinia and Zanzibar, females of the *Merope* group exhibiting stages intermediate between long-tailed mimetic females of *P. antinorii* and entirely tail-less ones of *P. cenea*.

While dealing with this case, I would add that, until recently, of all the various tail-less continental females of this group known to me, the form *dionysos*—a rare phase of the West African *P. merope*—was the least modified as compared with the male,* for it

*'Iris,' III., pp. 333-336.

†For colored figures in three forms of *P. antinorii*, ♀, see Haase, *l. c.* II., Pl. I.

*See Trans. Ent. Soc., Lond., 1874, p. 178.

possesses merely a trace of the wide black bar that in two other forms divides the pale ground color into perfectly separate subapical and inner marginal spaces in the fore wings, and the hind wings are ochre-yellow with a narrow black border.* Professor Poulton has, however, kindly shown me, in the Hope Collection of the Oxford University Museum, a much closer approximation to the masculine coloration in an extraordinary example of the female *P. cenea* from Zanzibar. In this female the transverse trace of black in the fore wings is even fainter than in the *dionysos* form, and the color of the wide pale spaces and hind marginal spots in all the wings is almost exactly of the pale creamy-yellowish tint of the male *P. cenea;* and on the under side, while the pale-yellowish of the fore wings is better divided by blackish than on the upper side, the coloring of the hind wings corresponds much more nearly to that of male than in any other female I have seen—the characteristic break in the submarginal brownish band being moreover very complete and wide. There can be no doubt that in this specimen we have a marked case of reversion to the original coloring of the female, but it is unaccompanied by any inclination towards the recovery of the lost tail of the hind wings.

Returning to the general aspects of the subject, it is of importance to consider more closely how the evidence stands in relation to (*a*) persecution by insectivorous foes; (*b*) possession of malodorous and distasteful juices by certain groups; (*c*) rejection or avoidance by foes of the insects provided with offensive juices, and (*d*) loss occasioned to distasteful species by the attacks of young and inexperienced enemies; for it is admittedly on the cooperation of these factors that the theory of mimicry depends.

*Hewitson (Exot. Butt., IV., Papilio XII., fig. 39) delineates an example in many respects intermediate between *dionysos* and *hippocoon*, but rather closer to the latter form as regards the fore wings.

(*a*) As regards the first point, the broad fact of insects generally constituting the food of countless devourers, vertebrate and invertebrate, is beyond dispute; immense and incessant persecution is universally at work. But when we proceed to examine this world-wide persecution more in detail, and to ask in what special directions it works, or what groups or species are the particular prey of certain groups or species of enemies, we very soon discover how little is exactly known. Birds, for instance, are such notorious and apparently indiscriminate insect-eaters, and some of them are so active and demonstrative in their hunting, that it seems but reasonable to regard them as the chief pursuers on the wing of the abundant and defenceless butterflies. Yet in the discussion which followed the reading of Dr. Dixey's last paper, above referred to, nothing was more noticeable than the very scanty testimony to such persecution on the part of birds that could be brought forward by the very competent well-travelled entomologists present. In fact, the poverty of observed cases of such attack has induced the opinion among some entomologists that birds very rarely chase butterflies at all, and the published expression of this view by Pryer, Skertchley, Piepers and other experienced collectors cannot be overlooked. But I am persuaded that in this instance, as in so many others where the life-history of animals is concerned, the dearth of evidence is due to the neglect of well-directed and sustained observation. Little can be gained by merely noting such cases as happen to force themselves on the collector's attention; the collector must resolutely set himself to search out and keep watch upon what really takes place. Considering that there is no record of any naturalist's having seriously taken up the investigation of this matter in the field, I think that very much positive evidence could hardly be expected, and that

what has been published goes far in the direction of proving that birds must still be reckoned among the principal enemies of butterflies. Belt's well-known note on the pair of Puff-birds that he watched for half-an-hour bringing various butterflies to feed their young is supported by E. Poeppig's observation* that in the forest it is easy to discover where a *Galbula's* favorite perch has been chosen, as the wings of large butterflies, whose bodies only have been eaten, strew the ground for several paces round about. Von Wied found a large 'Tagschmetterling' in the stomach of a *Bucco*, and E. Hartert butterflies in that of *Merops pusillus*; while E. L. Arnold saw *Terias hecabe* and *Papilio pammon* caught by birds in India.† Hahnel published in *Iris* (1890) the observation that in South America birds hunted Pierinæ more than any other group of butterflies, and often snapped up specimens close to him. Haase in Siam saw some Catopsiliæ (Pierinæ) and Hesperiidæ captured and eaten by sparrows. I have recorded Mrs. Barber's remarks that among the insects caught and brought to their nestlings by various Sun-birds at the Cape she often noticed *Pyrameis cardui*, and also Mr. Mansel Weale's note that *Tchitrea cristata* captures the male *Papilio cena*. Mr. T. Ayres, a very trustworthy ornithological observer, has remarked (in his notes in *The Ibis* on the habits of South African birds) that the King-hunter, *Ispidina natalensis*, feeds almost entirely on butterflies. Col. Swinhoe informs me that in India he has on several occasions seen *Merops viridis* catch and eat butterflies, and that he has also witnessed many cases of other birds pursuing them; while the common *Corvus splendens* was found greedily to devour any edible butterflies thrown to it. This evidence is supported by that kindly furnished to me by Mr. F. Lewis, of the Ceylon Forest Service, who has for many years been familiar with the ways of birds in the jungle, *vid.*: that he has seen *Merops viridis* and *M. philippinus* occasionally take small white and yellow butterflies (*Terias, spp.*), and the latter bee-eater and *M. swinhoii* frequently capture Catopsiliæ, especially when these butterflies are traveling in thousands along the river valleys. Mr. Lewis also gives *Buchanga leucopygialis* as a very active hunter of butterflies on the wing. In England I have noticed a swallow hunting one of the common 'Whites' (apparently *Pieris brassicæ*), and also three sparrows for some time chase and eventually capture a female *Epinephile janira*; while at the Cape I have seen *Fiscus collaris*, the common shrike of the colony, seize in succession several newly-emerged *Papilio lycæus* on the wing.

In Mr. Skertchley's paper, 'On Butterflies' Enemies,'* he gives a list (p. 485) of no fewer than twenty-three species of butterflies belonging to the different subfamilies, which he observed in Borneo with both hind wings mutilated in the same manner as if a piece had been bitten out while the insect was at rest; but this description of mutilation he attributes, not to the assaults of birds, but to those of lizards and perhaps small mammals. I see nothing, however, to lead us to conclude that birds do not attack butterflies when at rest, especially when settled on flowers, foliage, etc., with closed and erect or pendant wings; it is highly probable, indeed, that they would mark down a settling butterfly and make direct for it. It seems to me likely that most of the destruction of butterflies by birds is not effected by the difficult chase of these wavering and erratic or often very rapid flyers in the open, but is carried on mainly against the slow-flying bulkier females while engaged in depositing their ova, usually among the foliage of trees, un-

*Cited by Haase, l. c., II., p. 104.

†These three cases also cited by Haase, l. c.

*Ann. & Mag. Nat. Hist. (6) III., pp. 477–485 (1889).

dergrowth or herbage, where they would be almost unnoticed by the collectors. An equally, if not more, dangerous time for butterflies of both sexes is during courtship and pairing, when they are less on their guard than at any other period, and those actually paired (unless very well concealed by close resemblance of their under side to the immediate surroundings) have little chance of escape.* Colonel Swinhoe has mentioned to me that birds often do not seem inclined to take the trouble to give chase to flying butterflies, but sit merely watching them, and this is in support of the view that they more frequently adopt the easier plan of attacking them when feeding, settling or at rest. The frequency of the cases where mimicry is confined to the female points with some significance to the probability that persecution is more directed against that sex than against the male.

(*b*) The presence of malodorous juices in many insects is a matter of common observation, and is a protective property possessed by several entire groups, especially among the Lepidoptera and Coleoptera. There is abundant evidence as to the prevalence of these secretions, and among the Lepidoptera they are particularly developed in the butterflies of the groups Danainæ, Neotropinæ, Acræinæ and Heliconinæ, and also in some Papilioninæ, as well as in many moths of the groups Agaristidæ, Chalcosiidæ, Arctiidæ, Lithosiidæ, etc. The strength of the disagreeable odor emitted is in some species very great;† Seitz, for instance, mentioning that that the smell of the South American *Heliconius beskei* and *Eucides aliphera* extends over a radius of several paces, and Wood-Mason and De Nicéville testifying to the same effect as regards the Indian *Papilio philoxenus* and allied forms. When molested many of these offensively-smelling species exude drops of a yellow or whitish fluid which leave on anything they touch a stain and odor difficult to remove, as I have experienced in the case of the Mauritian *Euplœa euphone*, the South African Danainæ, and various South African Agaristidæ, Glaucopidæ and Arctiidæ.

The origin and manner of acquisition of these unsavory secretions have yet to be discovered; the suggestion (so much insisted on by Haase) that these juices are directly derived from those of similar quality in the food plants of the larvæ arising from the long-known circumstance that some of the food plants of species in the protected groups are of an acrid or poisonous character, such as (*e.g.*) Asclepiads in the case of many Danainæ, and Aristolochia in that of the inedible forms of Papilioninæ. No doubt, too, the fact that the unpleasant qualities are very often fully developed in the larvæ of the distasteful species—as I have found with *Danais chrysippus* and various Acrææ—lends some weight to the suggestion; but at present nothing approaching sufficient data can be brought forward respecting the actual food plants to which the protected groups, in contrast to the unprotected, are thought to be restricted. It cannot be gainsaid, as Professor Poulton has pointed out,* that the food plants of many of the distasteful European moths do not belong to any poisonous or acrid category; and his own and Mr. Latter's papers on *Dicranura vinula* alone amply demonstrate what powerful acids can be elaborated by a larva which finds its food in such innocuous plants as poplar and willow. The supposed direct derivation of the nauseous juices from the plants consumed is thus plainly a matter that awaits

* It is not improbably in these circumstances that the imperfectly mimetic but still 'warning' under side of the male in *Perrhybris* becomes specially serviceable (*Cf.* Dixey, Trans. Ent. Soc. 1896, p. 71).

† Cited by Haase, *l. c.*, II., p. 101.

* Proc. Zool. Soc. Lond., 1887, pp. 198, etc., and *Nature*, 4th Nov., 1897, p. 3.

investigation from both biological and chemical standpoints.

(*c*) The avoidance or rejection as food by insectivorous animals of the insect possessing malodorous or distasteful juices no longer rests merely on the negative evidence given by Bates, Wallace, Belt and other competent observers, to the effect that in nature such distasteful forms are habitually neglected and unmolested; there is now much positive experimental evidence as to the manifest avoidance or disgust with which such species are left untouched, or thrown aside after tasting, when offered to domesticated or captive vertebrate animals that devour ordinary insects with avidity. The numerous experiments of this kind recorded by Butler, Jenner Weir, Weismann, Poulton and Lloyd-Morgan, as regards both larvæ and imagos of European species, are supported by a few made by Belt with Heliconiinæ in Central America, by D'Urban and myself with Danainæ and Acræinæ * in South Africa, and by Haase with Danainæ in Singapore.

It is manifest, of course, that even the most distasteful forms cannot enjoy complete immunity from persecution; in ordinary circumstances they are doubtless mainly kept down by parasitic insects, † and during any scarcity of more palatable prey it is certain that they will be devoured *faute de mieux* by vertebrates and invertebrates alike. To the latter condition are perhaps due such cases as Distant's ‡ note of the orthopterous *Hemisaga* devouring an imago of *Danais chrysippus*; Col. Yerbury's * observation that in Ceylon *Euplœa core* and *Delias eucharis* were largely taken by a Mantis, and *Danais limniace* by two kinds of Asilidæ; and Belt's remark that a flower-frequenting spider captured Heliconiidæ.

(*d*) As regards the important point whether the protected forms have to suffer a certain percentage of loss from the attacks of young and inexperienced birds and animals, it must be admitted that the evidence at present forthcoming is exceedingly scanty; and I have long felt considerable doubt as to the sufficiency of this factor to account for the mimetic resemblances, often remarkably close, between members of associated protective groups. But on reviewing carefully the recorded observations which appear to bear on the question, I have found reason to think that there is enough support to justify the provisional acceptance of the Müllerian explanation. We have, in the first place, Fritz Müller's own capture of Heliconii and Acræinæ with a notched piece bitten out of the wings, and Distant's (*l. c.*, p. 65) of a *Danais chrysippus* whose wings had been bitten unsymetrically, apparently by a bird. Then there is the significant record of Skertchley (*l. c.*, p. 485) who, among twenty-three species of Bornean butterflies taken with both hind wings mutilated in the same manner, notes no less than four Danainæ, *vid.*, *Hestia lynceus*, *H. leuconœ*, *Ideopsis daos* and *Euplœa midamus*. Moreover, it is very remarkable that several of those entomologists who have specially emphasized the small part played by birds in attacking butterflies mention, among the few cases of such attack as they witnessed, instances of protected forms being assailed, Sir G. Hampson † remarking that in south India the Euplœæ and Danaids were caught as often

* De Nicéville (Butt. Ind., etc., I., p., 318) notes that *Acræa violæ* was the only butterfly rejected by all the species of Mantidæ which he offered various butterflies.

† C. V. Riley (apud Haase, *l. c.*, II., p. 47) found that a dipterous parasite was very prevalent in the larvæ of *Danais archippus*, often destroying a whole brood.

‡ Nat. in Transvaal, p. 65 (1889).

* Proc. Ent. Soc. Lond., 1897, p. xl.

† Proc. Ent. Soc. Lond., 1897, p. xxxvii.

as any others, and M. Piepers* that in two of the four cases which he had seen in Sumatra and Java the species seized were Euplœæ.

The question underlying this is manifestly whether insect-eating animals have an instinctive inherited discernment of what species are unfit for food, or whether, on the contrary, each individual has to acquire this necessary knowledge by personal experience, aided in some vertebrate groups by parental guidance. So numerous and so marvelous are the instinctive or congenital activities of animals—especially in the insect world, where past experience or parental instruction is almost always non-existent—that there has been a very general disposition on the part of naturalists to incline to the former view in a matter so all-important as suitable food. Yet, so far as experiment has hitherto gone in this direction, there seems good ground for holding that—at any rate in such specially insectivorous vertebrate groups as birds, lizards and frogs—the young possess no such hereditary faculty of discrimination, but have to discover individually what to avoid. This appears not only from Mr. Jenner Weir's and especially Professor Poulton's careful and often-repeated experiments with lizards and frogs,† but also from Professor Lloyd Morgan's study‡ of newly-hatched birds of different orders, which indicates clearly with what complete want of discrimination every object of suitable size is at first pecked and tasted, but how soon experience tells and is acted upon. Professor Lloyd Morgan made special trial of these young birds with many distasteful insects and their larvæ, and states in conclusion (*l. c.*, p. 43) that he did not find a single instance of instinctive avoidance, but that the result of his observations is that "in the absence of parental guidance the young birds have to learn for themselves what is good to eat and what is distasteful, and have no instinctive aversions."

In concluding what I feel to be a very incomplete outline of what has been done in this most important branch of zoological research, I cannot refrain from expressing the gratification I find in noting how by far the chief part in the investigations pursued and in the deductions derived from them has from the outset been borne by Fellows of this Society. It is work on which we may with justice be congratulated, and which should encourage perseverance in the same and kindred lines of inquiry.

Here, as in many other biological researches, it cannot be too strongly insisted on that no result of lasting value can be hoped for without resort to the living animals among all the natural conditions and surroundings. It was not a stay-at-home theorist, familiar only with the dried specimens of the cabinet, that detected the meaning of mimicry and gave to science a rational explanation of the mystery, but an ardent explorer and naturalist, who devoted many of the best years of his life to field-work in tropical lands. I am the last to undervalue the knowledge of the systematist, which is absolutely indispensable to all intelligible record, and I fully recognize that no naturalist can be properly equipped for his work without a fair amount of systematic training; but philosophical discovery in any direction such as we are now considering can never be truly advanced without unflagging observation and experiment among organisms living in their environment. How, but by the closest and most exact attention to the entire life-history of animals in their native haunts can we expect to deal satisfactorily with such questions as this of mimicry, of protective resemblances generally, of seasonal dimor-

* Report of Intern. Zool. Congress, III. (Leyden, 1895), p. 460.

† See Proc. Zool. Soc. Lond., 1887, pp. 191, etc.

‡ 'Habit and Instinct,' pp. 29–58.

phism, sexual selection, local variation, and the like? Admitting gratefully the good work of this kind which has been carried on in Europe, and especially in our own country, one cannot but regret that from tropical regions, where alone the abundance, complexity and incessant activity of life afford full prospect of the adequate reward of such research, we have little more than isolated notes and unconnected and incomplete observations, mere indications—precious as they are—of the rich harvest that lies unreaped for lack of resident workers devoted to the task.

It is on this account that I earnestly renew the plea, put forward from this chair on the 5th of May last, for the establishment, in tropical countries, of Biological Stations for the study of the terrestrial fauna; where, as in the existing Marine Biological Stations, naturalists could follow, during a succession of seasons, special lines of observation and experiment under favorable conditions of laboratory and other equipment, free from the hindrances and distractions of ordinary collecting travel, and with all the advantages of mutual help and encouragement. The living expenses, for men of the simple tastes of the naturalist, would not be great; and I feel certain that, with the increasing facilities for swift transport, it would not be long before many students of biology would embrace the opportunity so provided for the effectual prosecution of researches of the utmost value to science.

WILLIAM A. ROGERS.

PROFESSOR WILLIAM A. ROGERS was born at Waterford, Connecticut, November 13, 1832, and died at Waterville, Maine, March 1, 1898. His boyhood was spent for the most part in the interior of New York State, in the villages of DeRuyter and Alfred, where he received his preparation for college. In 1853 he entered Brown University, from which he was graduated in 1857. Before graduation he had already begun his career as a teacher in a classical academy, and immediately after taking his first degree he was appointed tutor in the academy at Alfred, N. Y., from which he had gone forth a few years previously as an exceptionally successful student. In 1859 he was advanced to the professorship of mathematics and astronomy in Alfred University, an institution under the care of the Baptist denomination, of which Professor Rogers was an ardent member throughout his life. This position he held eleven years, though absent part of this time for several specific purposes. Among these absences one was devoted to a year of study in the Harvard College observatory; six months were occupied in work as an assistant in the same place; fourteen months were given to service in the navy during the Civil War; and nearly a year was given to the study of mechanics in the Sheffield Scientific School at New Haven.

In 1870 Professor Rogers severed his connection with Alfred University for the purpose of becoming an assistant in the astronomical observatory at Harvard, and in 1875 he was here made assistant professor of astronomy. This position he retained until 1886, when he accepted the chair of physics and astronomy at Colby University, Waterville, Maine. Here the last dozen years of his life were spent; but had he lived a month longer he would have resumed his connection with Alfred University, where a new physical laboratory is now in process of erection. The building was planned by him in 1897, and on the occasion of the laying of the cornerstone, June 23, 1897, Professor Rogers delivered the dedicatory address. His resignation had already been offered to the Trustees of Colby University, to take effect April 1, 1898.

During the sixty-five years of his busy

life the most distinguishing characteristics of Professor Rogers, as a student and teacher of science, were his indomitable perseverance, industry, care, patience and accuracy. Beginning as a teacher of pure mathematics, he passed naturally into specialization in astronomy and its allied neighbors, mechanics and physics. His delight was minute measurement, with accuracy to the last decimal place that patient industry could render attainable. He sought accuracy not merely for the securing of the best practical results, but because he had a veritable passion for its pursuit. The first time that the present writer came into contact with him was at the Boston meeting of the Scientific Association in 1880, when he gave the outcome of an elaborate comparison between the standard French meter and the imperial yard, the uncertainty being in the value of the digit occupying the place of ten-thousandths of an inch. Another result almost identical with the first was reported in 1882 at Montreal as the outcome of new measurements, the meter being equivalent to 39.37015 inches under standard conditions. Still another was given a year later at Minneapolis, 39.37027 inches. At Philadelphia, in 1884, he announced a re-examination of his data, with the expression of his conviction that this result was a little too high, but that the true value could not be less than that given at Montreal. At Buffalo, in 1886, 39.37020 inches was given as a new determination. In 1893, as the mean of eleven determinations, he gave 39.370155 inches. This may be taken as a final value. It has been subjected to two or more revisions by him since 1893, but with no appreciable change as the result. All physical measurements are necessarily only approximate. There are probably very few of them that have been made with a degree of exactitude superior, or even equal, to this one.

The scientific papers published by Professor Rogers are about seventy in number. The first, which appeared in 1869, was forty-five pages in length, and related to the determination of geographical latitude from observations in the prime vertical. He was at this time about thirty-seven years of age, and still connected with Alfred University, where the facilities for research were very limited. Under his direction in 1865 Alfred Observatory was built and subsequently equipped. His activity as a scientific worker was much stimulated after his connection with the Harvard Observatory became established. During the sixteen years of his residence in Cambridge he published forty scientific papers, most of which related to practical astronomy, such as the determination of star places, the calculation of ephemerides, the study of the errors of instruments, the construction of star catalogues from all known data, etc. Included in such work as this the study of the microscope as an instrument of precision was naturally developed, and the methods of securing accurate rulings for micrometers became a subject for the application of industry. This led Professor Rogers into the study of physical standards of length, and the construction of ruling machines, regarding which he made himself a generally recognized authority. The articles on 'Measuring Machines' and 'Ruling Machines' in the new edition of Johnson's Cyclopedia were written by him.

In all accurate measurements of length the recognition of the temperature at which they are made is a matter of prime importance, since a slight variation in temperature produces a measurable change of length. The recognition of this fact caused Professor Rogers to enter into an extended study of the limits of precision in thermometry, of radiation, and of coefficients of expansion. This continued to be his chief study during the closing years of his life.

Nevertheless, he kept numerous data from his work at Harvard, and published a number of astronomical papers after his removal to Colby University. His special interest, however, had been gradually transferred to the domain of physics. In the construction of micrometers he early experienced trouble on account of the scarcity of suitable spider webs, and this caused him to undertake the etching of fine lines on glass. So successful was he in this that a large number of his plates were secured by the representatives of the national government, and sent out for use by the observers on the occasion of the transit of Venus. During his study of standards of length he visited Europe, obtained authorized copies of the English and French standards, and brought these home with him. They were then used by him as the bases of comparison for bars which he constructed and ruled, and these are now the chief standards in a number of the most important laboratories in America.

Immediately after his removal to Colby University Professor Rogers undertook the study of thirty mercurial thermometers of the U. S. Signal Service pattern, and by comparison with these he secured a standard for the measurement of very low temperatures. It was about this time that Michelson and Morley developed the interferential comparator, and began their investigation regarding the use of the wave-length of sodium as a standard of length. Professor Rogers had already done much work with comparators, and he soon became associated with Professor Morley in the application of optical methods to the determination of minute changes of length. After proper adjustment of apparatus the measurement of almost infinitesimal expansion or contraction becomes possible by merely counting the number of interference fringes of monochromatic light which pass across the field of view in a given period of time. In this way Professor Rogers determined the coefficient of linear expansion of Jessop steel with a degree of precision never before attained. His work in this connection was presented at the Springfield meeting of the Scientific Association in 1895.

In his address last summer at the laying of the corner-stone of the new physical laboratory of Alfred University, Professor Rogers gave a summary of the kind of work which he proposed to undertake personally and with the cooperation of his more advanced students. Prominent among the subjects had in view were the study of the law of expansion of metals under changes of temperature, the standardization of measures of length, the separate measurement of the effects of hot air and of the heat conveyed by radiation, the energy of heat radiations as determined with the interferometer, the development of the construction of precision screws, the practical development of methods of precision in work-shop operation, the investigation of the relative cost and efficiency of small sources of power, of the economy of various methods of heating, and of methods for generation of X-rays. This is an excellent summary of the work to which he had been devoting his energies for some years past.

In acknowledgment of his scientific work Professor Rogers was elected, in 1873, to membership in the American Academy of Arts and Sciences at Boston. In 1880 he received the honorary degree of A.M. from Yale, and during the following year he was made an Honorary Fellow of the Royal Microscopical Society. In 1886 he received the honorary degree of Ph.D. from Alfred University, on the occasion of the semi-centennial of this institution, and in 1892 Brown University conferred the degree of LL.D. In 1895 he was elected to membership in the National Academy of Sciences. In addition to these recognitions of merit he was made Vice-President of the American Mi-

croscopical Society in 1884 and President in 1887; Vice-President for Section A of the Scientific Association in 1882 and 1883, and Vice-President of Section B in 1894. The subject of his vice-presidential address in 1883 was 'The German Survey of the Northern Heavens;' in 1894 it was 'Obscure Heat as an Agent in producing Expansion of Metals under Air Contact.'

Personally Professor Rogers was one of the most unassuming of men, always kindly and considerate in his dealings with others, yet honest and outspoken. With apparently no conception of the meaning of fatigue, he was ever ready to devote hundreds of hours, if need be, to the solution of any problem that he deemed of scientific importance. His time and labor were given freely, with no expectation of reward beyond that which springs from the consciousness of success. He leaves many friends and no enemies, and to the cause of pure science his death is a sad loss.

W. Le C. S.

SIXTH ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION.

The American Psychological Association held its sixth annual meeting at Cornell University on December 28, 29 and 30, 1897.

For some years the number of papers offered at the meetings has been so great as to crowd the program to a point of serious inconvenience, and as a consequence the experiment was tried this year of holding simultaneous sectional meetings for the reading and discussion of technical papers, a plan which was apparently successful and will probably be followed in the future.

As might be expected from the traditions of the Association, experimental psychology predominated in the number of papers offered, but both general psychology and philosophy were well represented. Two formal discussions were held, one on 'Physical and Mental Tests,' on the 28th, and one on 'Invention,' on the 29th. The President of the Association, Professor J. Mark Baldwin, presided at the meetings.

The opening session was given up to experimental papers, the first being by Dr. J. P. Hylan on 'Fluctuation of Attention.' The speaker presented experimental results and offered the theory that each object of attention innervates certain nervous elements in the cortex, distinct to a considerable degree from those innervated by other objects, and that the comparative exhaustion of one set of elements causes another set to function and the direction of the attention to change or fluctuate in accordance with this change of function.

Dr. Charles H. Judd read a paper on 'The Visual Perception of Depth,' which aimed to show that there is no direct perception of depth by means of the sensations of a single retina unaided by sensations of movement or by binocular factors. The argument was supported by a demonstration of certain visual illusions.

Professor J. McK. Cattell described experiments showing that the time of discrimination increases as the difference in the intensity of two sensations is decreased, and spoke of the application of this principle as a method in psycho-physics. Professor Cattell also described a method for studying muscular fatigue in its relations to mental conditions and exhibited a new instrument for fatigue experiments in which a spring dynamometer is substituted for the lifted weights of Mosso. Results thus obtained were shown which do not altogether confirm those of Mosso.

Dr. E. W. Scripture presented a brief summary of recent investigation at the Yale Psychological Laboratory, the publication of which will follow in the 'Studies' from that institution.

Mr. Albert H. Abbott spoke on 'Color Saturation,' reporting results reached by

experimenting with discs constructed so as to show the same intensity over the whole disc, the same color-tone and a gradual transition from the full color-tone to gray; thus isolating saturation changes.

The following papers of an experimental character were read by title: 'Time Measurements of Visual After-Images,' by S. I. Franz; 'Class Experiments,' by A. Kirschmann; 'Recent Discussion of Color Theory,' by Mrs. Christine Ladd Franklin; 'Experiment in the Psychology of Perception,' by Brother Chrysostom.

The discussion on 'Invention' was led by Professors Royce and Jastrow and Dr. Urban, while Professor Baldwin's presidential address on the related topic, 'Selective Thinking,' which he was unfortunately prevented from reading, was in printed form and in the hands of the members for reference.

Professor Baldwin's paper discussed the material of selective thinking, the function of selection (how certain variations are singled out for survival), the criteria of selection (what variations are singled out for survival) and certain resulting interpretations, treating the problem of race evolution in the light of the author's well known theory of 'organic' selection.

Professor Royce took up the subject of 'The Psychology of Invention' and after defining the problem and, analyzing the general conditions which favor inventiveness, presented interesting results of experiments devised to encourage in simple form individuality and inventiveness. The method chosen was the drawing by the subjects of figures or combinations of curves and straight lines under varying experimental conditions. This paper, as well as Professor Baldwin's, has been published in full in *The Psychological Review*.

Professor Jastrow followed with a paper treating the problem from the point of view of anthropology, and Dr. Urban discussed at some length the limits of the 'Application of the Utility-Selection Hypothesis to Mental Phenomena.'

Two years ago a Committee of the Association was appointed to inquire into the subject of physical and mental tests and to agree, if possible, upon a series of such tests suitable for use with the undergraduates of our universities. This Committee is still at work and in connection with its report this year a discussion was held, opened by Professor Jastrow, with a paper on 'Popular Tests of Mental Capacity.' The speaker took up first the selection of the capacities to be tested and the practical methods of testing them, emphasizing the importance of devising specific typical tests rather than general ones and of obtaining information regarding a single or a very limited group of powers, the advantages of which in the interpretation of results are obvious enough. He then discussed in turn treatment of the senses, the motor capacities and the more complex mental processes.

Professor Baldwin spoke briefly, laying particular stress upon the importance of memory tests, and Professor Cattell, as Chairman, discussed the report of the Committee embodying the results of its work thus far and recommending that a series of tests which can be made upon one subject in one hour be made as far as possible in all psychological laboratories, that a variety of tests and methods be tried and the results reported to the Committee. This Committee, consisting of Professors Cattell, Baldwin, Jastrow, Sanford and Witmer was continued and an appropriation made from the funds of the Association for carrying on its work.

The following papers were also presented at the meeting: 'The Place of Experimental Psychology in the Undergraduate Course,' by Professor F. C. French; 'Concept of Sensation,' by Dr. E. A. Singer, Jr.; 'The Intellectual Content in Dream Con-

sciousness,' by Dr. Robert MacDougall; 'Morality in Child Life,' by Dr. Albert Schinz; 'Professor Titchener's View of the Self,' by Professor William Caldwell; 'Aristotle's Doctrine of ψυχή as Biological Principle,' by Professor William A. Hammond; 'Epistemology and Theories in Physical Science—A Fatal Parallelism,' by Professor A. H. Lloyd; 'Romanes and Mill,' by Professor J. G. Hibben; 'Contributions of Psychology to Morality and Religion,' by Professor J. G. Hume.

Informal communications were also made by several members of the Association.

At the regular business meeting Professor Hugo Münsterberg, of Harvard University, was elected President of the Association for 1898; Dr. Livingston Farrand, of Columbia University, Secretary and Treasurer, and Professors J. E. Creighton, A. Kirschmann and E. B. Delabarre to fill vacancies in the Council.

It was also decided to hold a summer meeting in 1898 at Boston at the time of meeting of the American Association for the Advancement of Science and that the next annual meeting should be at Columbia University, New York, that place having been chosen by the affiliated societies upon invitation from the University.

Livingston Farrand.
Columbia University.

THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The seventh session of the Australasian Association for the Advancement of Science was held at Sydney from January 6th to January 14th, under the presidency of Professor A. Liversidge. There was a large attendance and full program, no less than 269 papers being presented before the ten sections.

The President, in his address, after referring to the losses the Association had suffered in the deaths of Sir Robert G. C. Hamilton, Baron von Müller and Professor Parker, gave an account of the work of the Association since its first meeting in August, 1888, under the presidency of Mr. H. C. Russell, when 850 members were present. Since then meetings have been held in Melbourne, Christchurch (N. Z.), Hobart, Adelaide and Brisbane. In referring to the last session at Brisbane, in 1895, he called attention to the research committees then appointed. Chief among these were (1) the committee reappointed for the investigation of glacial deposits; (2) the seismological committee; (3) a committee to consider and report upon the thermodynamics of the voltaic cell; (4) the geology, land flora, land fauna and natural resources generally of the islands and islets of the Great Barrier Reef; (5) the habits of the teredo and the best means of preserving timber or structures subject to the action of tidal waters; (6) the committee to give effect to the suggestions contained in Sir Samuel Griffith's paper, entitled 'A Plea for the Study of the Unconscious Vital Processes in the Life of a Community.' The Association had published six volumes of reports, each of about 1,000 pages. Professor Liversidge then proceeded to give an account of the history, teaching and recent advances of chemistry.

The addresses of the Vice-Presidents before the sections were as follows: *Astronomy, Mathematics and Physics*, 'Astronomy and Terrestrial Physics,' by Mr. P. Baracchi, Government Astronomer of Victoria; *Chemistry*, 'The Constitution of the Matter in the Universe,' by Mr. William M. Hamlet; *Geology and Mineralogy*, 'Early Life on the Earth,' by Professor F. W. Hutton, F. R. S.; *Biology*, 'The Relations of Morphology and Physiology,' by Professor C. J. Martin; *Geography*, 'Submarine Geography,' by Sir James Hector, F. R. S.; *Ethnology and Anthropology*, 'Origin of the Aborigines of Tasmania and Australia,' by Mr. A. W. Howitt;

Economic Science and Agriculture, 'Consumable Wealth,' by Mr. R. M. Johnston, Government Statistician of Tasmania; *Engineering and Architecture*, 'Notes on Some Recent Engineering Experiences,' by Mr. A.B. Moncrieff; *Sanitary Science*, 'Aspects of Public Health Legislation in Australia,' by Hon. Allan Campbell; *Mental Science and Education*, 'The Influence of English History on English Literature,' by Mr. John Shirley.

The report of the Glacial Research Committee, South Australia, was submitted by Professor T. W. E. David and Mr. Walter Howchin. The localities dealt with were comprised within the peninsula which formed the southern limits of the Mount Lofty Range. In 1859 Mr. Alfred Selwyn, at that time Government Geologist of Victoria, whilst travelling through the Inman Valley, discovered a polished rock surface, which, to the practiced eye, exhibited clear proof of glacial action. This was the earliest discovery of its kind in Australia, but the position was lost sight of until re-discovered by the authors of the paper in March last. This polished pavement, which measured over 20 feet in length and 6 feet in breadth, occurred in the bed of the Inman River, a little past the seventh mile post from Port Victor. The glacial beds of the Inman River have at present an elevation of over 600 feet above sea level. If, therefore, the agency of shore-ice as the means of distribution were admitted, they must assume that there had been an elevation of the land since the days of glaciation. The facts were, perhaps, best explained by reference to a combination of agencies, rather than to a single form of ice action.

In presenting the report of the Seismological Committee, the Secretary, Mr. George Hogben, M.A., of Timaru, New Zealand, referred to the work already done in his own colony through the officers of the Telegraph Department, who, on the occurrence of any earthquake shock, filled up certain forms, stating the exact time and duration and such other details of the earthquake as might be useful to the seismologist. By means of these observations the sources of many of the earthquakes had been accurately found, the velocity of propagation determined, as in general rather under 20 miles a minute; in a few cases the depth of the origin was also ascertained, the deepest one found so far coming from a point about 24 miles below the earth's surface. This work has been done in New Zealand since 1889, and the other colonies had been asked to follow suit. This they had done to a certain extent, but the committee was anxious that the system should be developed and made uniform throughout. Of recent work the most interesting item was probably the fact, based upon rough calculations from returns sent by Sir Charles Todd, Professor Bragg and others, that the great South Australian earthquake of May 10, 1897, proceeded from a line parallel to the coast near Beachport and Kingston, and was possibly due to a sliding of one part of the crust upon another, such as forms what was called in geology a 'fault.' This was probably deep, but the later and slighter shocks were surface ones, caused by readjustment of the immediate crust. The subject was still under investigation by the Secretary.

At the final meeting of the General Council the following suggestions from the Recommendation Committee were agreed to: (1) That the New South Wales government acquire the quarry of prismatic sandstone at Bondi, with a view to its preservation as a remarkable geological occurrence. (2) The re-appointment of the Committee on 'The Systematic Conduct of the Photographic Work of Geological Surveys.' (3) A Seismological Committee for 1900. (4) The government of New Zealand to equip Timaru with approval seismological

instruments in charge of Mr. George Hogben. (5) A contribution of £25 towards the preceding object. (6) The appointment of a committee to secure magnetic surveys at the extreme south of New Zealand. (7) Expressing the opinion that the publication of Victorian continuous magnetic records is desirable. (8) That the committee be re-appointed to continue the investigation of the mineral waters of Australasia. (9) That the New South Wales government be recommended to complete the borings at Funafuti while the bore apparatus remains on the island and the bore remains open. (10) A committee be appointed to draw up a list of works and papers relating to Australian flora.

The report from the Baron von Müller Memorial Committee, embodying a resolution, "That the Association places on record its sense of the deep loss sustained by it owing to the death of the late Baron von Müller, and its high appreciation both of his personal character and the distinguished services rendered by him to science," was adopted.

It was announced by Professor Liversidge that communications had been received from the Royal Society regarding the compilation of the Australian portion of an international catalogue of scientific literature, and at the instance of the Chairman an advisory committee, with power to add to its number, was appointed, consisting of representatives from all the colonies. This committee recommended that some recognized society in each colony should collect all necessary matter and forward it to the central bureau, London.

A committee consisting of Professor Lyle, Mr. W. H. Steele and Mr. E. F. J. Love (Secretary), appointed to investigate and report on 'Our Knowledge of the Thermodynamics of the Voltaic Cell,' presented their report.

The usual excursions, entertainments and public lectures were given during the week, and the proceedings closed with a conversatzione given by the Royal Society of New South Wales, at which about 750 guests were present.

Mr. R. L. J. Ellery, late Government Astronomer of Victoria, was elected President for the next meeting of the Association, to be held in Melbourne in the year 1900. Mr. C. R. Blackett, Government Analyst of Victoria, was elected Treasurer, and Professor Baldwin Spenser and Mr. E. F. J. Love, M. A., were elected joint Secretaries. An invitation to meet in Hobart, Tasmania, in 1902 was accepted.

A PLACENTAL MARSUPIAL.

The discovery by James P. Hill, of the University of Sydney, N. S. W., that the Marsupial genus *Perameles* has a true allantoic placenta, is one of the most important of the many recent advances in our knowledge of the Australian Monotreme and Marsupial fauna. In a recent number of the *Quarterly Journal of Microscopic Science* Mr. Hill contributes his first paper to the embryology of the Marsupials, and describes the relations of the fœtal membranes observed in *Perameles*, as represented in the accompanying figure.

The presence of this organ, which has hitherto been considered entirely distinctive of the Placentalia or Eutherian mammals, in a non-placental, is of great significance, and Dr. Hill concludes his paper by a brief inquiry as to the conclusions which may be legitimately drawn from it as follows: The main question is: has the allantoic placenta of *Perameles* been independently evolved within the limits of the Marsupial order, or is it directly or genetically related to that of the Placentals through the common ancestry of the Metatheria or Eutheria from an earlier Protoplacental stock?

It will be recalled that Huxley, in his

famous paper of 1880, upon the descent of the Mammals, derived the Marsupials from the Monotremes, and the Placentals from the Marsupials. Other writers have disputed this position. Gill had previously united the Marsupials and Placentals as Eutheria. In 1893 Osborn, upon paleontological and odontological grounds, considered the Marsupials as a parallel phylum with the in *Perameles* has led him to adopt the 'parallel' interpretation, deriving both the Placentals and Marsupials from a Protoplacental stock. According to this interpretation, the Marsupials are to be considered in placentation, as in dentition, in a condition of decadence. Thus he says: "In our view, it is unnecessary to trace the placental ancestry of Eutheria back into the mar-

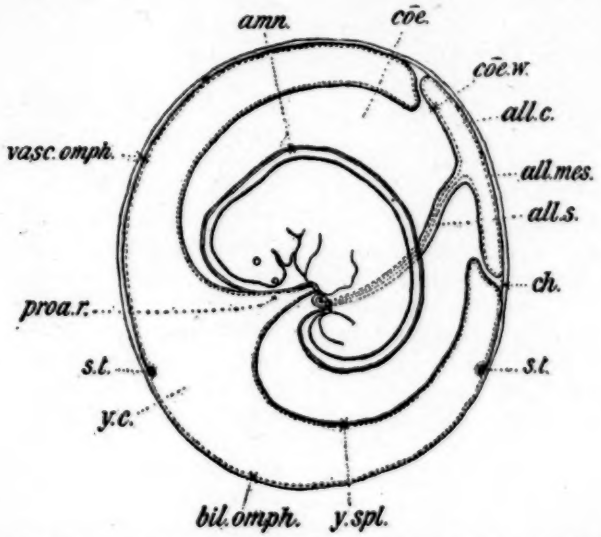

Diagram showing the arrangement of the fœtal membranes in Perameles: *amn.*, Amnion. *all. c.*, Allantoic cavity. *all. mess.*, Allanto-chorionic mesenchyme. *all. s.*, Allantoic stalk. *bil. omph.*, Bilaminar omphalopleure. *ch.*, Marginal zone of true chorion around the allanto-chorionic area. *cœ.*, Extra-embryonic splanchnocœle. *cœ. w.*, Inner or cœlomic wall of allantois. *proa. r.*, Persistent remnant of proamnion. *s. t.*, Sinus terminalis. *basc. omph.*, Vascular omphalopleure. *y. c.*, Cavity of yolk-sac. *y. spl.*, Invaginated yolk-sac splanchnopleure. The ectoderm is represented by a thin line; the entoderm by a dotted line, and the mesoderm by a thick line.

placentals arising from a common stock, and independently differentiated. In a discussion of the tooth development of *Perameles*, Dr. Hill and Professor Wilson, of Sydney, in 1897, advocated the same view. Semon, however, suggested, in 1896, that the Placentals were derived from Marsupials through a *Perameles* and a *Phascolarctus* type, thus supporting Huxley's original position.

Hill's study of the placental phenomena supial group. The occurrence there of a true allantoic placenta, and its absence in the majority of members of the order, do, no doubt, at first sight, suggest that in this group we must find the first beginnings of the organ. But we believe that the explanation is to be found in the fact that marsupials are, after all, a markedly specialized group, and that in it conditions have obtained producing placental disap-

pearance, just as conditions (probably identical in character) have determined the degeneration of other early nutritional arrangements, *i. e.*, the milk-teeth. We, therefore, fall back upon the view that the Metatheria and Eutheria are the divergent branches of a common ancestral stock, which was not only diphyodont but also placental."

H. F. O.

CURRENT NOTES ON ANTHROPOLOGY.

THE TSIMSHIAN INDIANS.

In 1894 Count von der Schulenberg published in Germany a bulky quarto of nearly four hundred pages on the language of the Tsimshian Indians. Very few people, either in Germany or among ourselves, know where the tribe, of some 3,000 souls, dwells. Dr. G. A. Dorsey, therefore, did a good piece of work when he wrote for the *American Antiquarian* (October, 1897, and reprint) a few pages on their geographical location, and added a map to make it clear. He refers to their myths and names their villages, modern and ancient. He closes his useful article with the common and fateful forecast: "The fate of the Tsimshian, as with his brother elsewhere on this continent, is to disappear."

CAVE HUNTING IN YUCATAN.

Under this title Mr. Henry C. Mercer delivered a lecture before the Massachusetts Institute of Technology which has been reprinted from the *Technology Quarterly* of December, 1897. It is a brief description of the work he did in Yucatan as given at length in his volume, the 'Hill Caves of Yucatan.' The lecture is illustrated with half a dozen very well printed photographs, and sets forth clearly the results of his researches.

Mr. Mercer thinks it necessary, toward the close of his lecture, to defend the expedition from the charge of failure. No one could have advanced such a charge who was capable of understanding the value of the results he obtained. He is quite right in vindicating for them an important position in the ancient history of Mayan civilization; though it would probably be going too far to say that they exclude the possibility of finding the traces of 'fossil man' in Yucatan.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

Our knowledge of the carbids has been decidedly increased by a new series of experiments by Moissan described in the *Comptes Rendus*. It has been known that it is impossible to obtain carbids of sodium, potassium or magnesium in the electric furnace. These are readily formed, however, by heating the metal in acetylene gas. Potassium, indeed, acts on acetylene at ordinary temperatures with the formation of C_2HK, a compound intermediate between potassium carbid and acetylene and which yields acetylene with water. The corresponding sodium compound C_2HNa when heated to nearly the softening point of Bohemian glass decomposes into acetylene, carbon and metallic sodium. Magnesium carbid, similarly formed, decomposes in the electric furnace into carbon and metallic magnesium. The explanation of the impossibility of forming these carbids in the electric furnace is that at so high a temperature the carbid is completely decomposed. Indeed, in the manufacture of calcium carbid, if the current is too strong (in one experiment 60 volts and 1,200 amperes), the calcium carbid formed is decomposed into graphite and metallic calcium, the latter distilling off. Thus the stability of the alkaline carbids is much less than that of the alkaline earthy carbids.

The fifth edition of the little brochure 'Data concerning Platinum' has just been published by Baker & Co., of Newark, N. J.

In addition to its very full and illustrated description of various forms of platinum apparatus, it has notes on the care and cleaning of platinum ware, and a series of valuable tables which include the current required to fuse platinum wire of different sizes, weight of platinum wire of different sizes and foil of different thicknesses from 0.00045 to 0.1 inch, length of platinum wire per troy ounce, and many others. It is a useful book for the laboratory. The same firm has issued a little booklet—'Platinum: sources of supply, identification and separation of the ore; facts of interest to prospectors and miners.' It is printed in the hope of stimulating a search for platinum in mineral localities and increasing the American supply. From it we take the following: "There are few, if any, of the gold-bearing beds of the world that have failed to yield platinum, and it is more than likely that large quantities of platinum ore have been thrown away with the black sand washings from gold placer deposits." In the list of localities where platinum has been found we note a perpetuation of the old error which includes North Carolina. This, which was based upon a supposed single specimen, was several years ago shown by Professor F. C. Venable, of the University of North Carolina, to be a mistake. In view of the increasing use of platinum, the discovery of further pay deposits of platinum in this country would be of great value.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

DR. W. K. BROOKS, professor of zoology at the Johns Hopkins University, was presented with his portrait on the evening of March 25th, on the occasion of the fiftieth anniversary of his birth. The presentation was made at Professor Brooks' home at Brightside, by Professor W. H. Howell, in the presence of twenty-two of the subscribers. The painting by Mr. Thos. C. Corner is regarded as an excellent likeness. A reproduction will be sent to each of the subscribers, who are for the most part former students of Professor Brooks, and include many of the leading zoologists of the United States. The committee which had the matter in charge consisted of Professor H. H. Donaldson, of the University of Chicago, chairman; Professors W. H. Howell and E. A. Andrews, of the Johns Hopkins University; Professor E. B. Wilson, of Columbia University; Professor H. V. Wilson, of the University of North Carolina; Professor S. Watasé, of the University of Chicago, and Professor T. H. Morgan, of Bryn Mawr College.

DR. TARLETON H. BEAN, Director of the New York Aquarium, has been asked to resign his office by the President of the Park Board. The conduct of the Aquarium under Dr. Bean has met with universal approval, and no reason is assigned for requesting his resignation. There is, in fact, probably none except the wish to secure an office with a salary of $4,000 for an adherent of Tammany Hall.

MAYOR VAN WYCK, of New York, has refused to sanction an appropriation for preparing the site in Bryant Park for the New York Public Library, and there is reason to fear that the new building may be long delayed.

REFERENCE was made in this JOURNAL some eighteen months ago to a subscription to defray the cost of a portrait of Mr. Herbert Spencer to commemorate the completion of his 'Synthetic Philosophy.' The portrait has now been completed by Professor Herbert Herkomer and will be sent to the Royal Academy this year. During Mr. Spencer's life-time it will hang in the Tate Gallery; afterwards, with the approval of the trustees, it will find its permanent home in the National Portrait Gallery.

IT is planned to secure a portrait of Lord Kelvin for the rooms of the Royal Society. Lord Kelvin was, it will be remembered, President of the Society from 1890 to 1895.

WE called attention, in the last issue of SCIENCE, to the memorial in memory of Buys Ballot, the eminent meteorologist. It may be added that Professor Willis L. Moore, Chief of the Weather Bureau, Washington; Dr. A. Lawrence Rotch, of Blue Hill Observatory,

and Mr. R. F. Stupart, Chief of the Weather Bureau, Toronto, are members of the National Committee, and subscriptions may be sent in their care.

Professor Felix Klein has been presented, on the occasion of the 25th anniversary of his professorship, with an album containing photographs of the present and former members of the Göttingen Mathematical Society.

Sir Henry Bessemer, the eminent metallurgist and engineer, who died in London on March 15th, at the advanced age of eighty-five years, should be regarded as a man of science as well as a great inventor. It is interesting to remember that his process for converting cast iron into cast steel was first presented before the British Association in 1856. The essence of Sir Henry's process was simply to blow a blast of air through the molten metal until it was sufficiently decarbonized, and this has been said by a competent authority to be one of the five great inventions of the century. The reduction in the price of steel that has resulted has had an immense effect on modern civilization, it being needful only to refer to the use of steel rails and the consequent reduction in the cost of transportation and to the possibility of erecting buildings twenty stories high. Sir Henry Bessemer could not persuade any manufacturer to use his process and was compelled himself to show its value, fortunately making many million dollars as a result. Sir Henry Bessemer made many other inventions, and spent the last years of his life in devising a reflecting telescope.

The death is announced of Professor Kirk, of New Zealand, the author of important works on the forests and flora of the colony, and of Dr. F. Hurter, a Liverpool chemist, who had made investigations in chemistry and physics, and of Dr. Jean Valentin, of Buenos Ayres, the geologist.

The Senate of the University of Glasgow has resolved to confer the degree of LL.D. on Alexander Duncan, B.A., Secretary and Librarian to the Faculty of Physicians and Surgeons, Glasgow; John Inglis, formerly President of the Institution of Engineers and Shipbuilders in Scotland, President-elect of the Institution of Marine Engineers, London; Dr. Elie van Rijckevorsel, of the Batavian Society of Experimental Philosophy, Rotterdam, and John Millar Thomson, F.R.S., Professor of Chemistry in King's College, London.

Mr. Alexander Agassiz gave a lecture in Saunders Theater, Harvard University, on March 24th, entitled 'The present state of theories of the formation of coral reefs,' giving an account of the important results of his recent investigations of the Fiji Islands.

The Michigan Academy of Sciences holds its annual meeting at Ann Arbor on March 31st and April 1st and 2d. The address of the President, Professor V. M. Spaulding, was on a 'State Natural History Survey.' The Michigan Schoolmasters' Club holds its annual meeting at the same time and place, scientific subjects occupying a prominent place in the program.

At a recent meeting of the Boston Scientific Society officers were chosen for the ensuing year as follows: President, H. Helm Clayton; Vice-President, Otto B. Cole; Secretary, Frank A. Bates; Corresponding Secretary, John Ritchie, Jr., and Treasurer, S. N. Norton.

The anthropological expedition from Cambridge University to Torres Straits, New Guinea and Borneo, to which we have already called attention, left England on March 10th, to be absent fifteen months. Very important results may be expected from the expedition, which is under the charge of Dr. A. C. Haddon, accompanied by six other men of science, peculiarly competent to investigate the natives—their physical characteristics, their mental condition, their folklore, their customs, their amusements, their songs, their language and their condition generally, as affected by their geographical environment.

In addition to the plans of the Geological Survey for explorations in Alaska, the Treasury Department are about starting five or six expeditions to explore the Yukon river, Copper river and other water routes of the Territory, Congress having appropriated $100,000 for the purpose.

Reuter's Agency is informed that Mr. H. S. H. Cavendish's proposed expedition to Lake Rudolph and the Nile has been postponed for

the present, after consultation with the Foreign Office.

THE German Meteorological Society will meet at Frankfort-on-Main on April 14th–16th.

THE ninth General Congress of Teachers of the Blind will be held in Berlin on July 25th next. Further information can be obtained from Herr Matthies, Secretary of the Congress of Teachers of the Blind, Steglitz, near Berlin.

A CONGRESS of the Italian Medical Association of Hydrology and Climatology will be held at Parma on April 3d, 4th and 5th.

THE Trustees of the Philadelphia Museums will, at their next meeting, consider the question of establishing branch museums in the principal cities of the Union.

THE National Museum has received from Mr. J. O. Cates, of Port Townsend, Washington, a five-foot example of the remarkable ragfish, *Acrotus willoughbyi*, which was discovered and described in 1887. Another strange fish reported several years ago, but not preserved, was probably an *Acrotus*. The present example, although somewhat mutilated about the head, has been cast and is now preserved in alcohol. Illustrations of this and allied forms are to be seen in Oceanic Ichthyology by Goode & Bean, Pl. LXII.

IT is reported that the German Government is considering the creation of a department of health under a responsible minister, replacing the present medical bureau under the Department of Public Instruction.

THERE is a bill at present before the New York Legislature providing that no patent medicine shall be sold or exposed for sale in the State, unless the formula is printed on the label of the bottle or package containing such medicine, and also on the outside wrapper.

THE Government of India has decided that it is unable to undertake the establishment of a physical laboratory.

M. PHILIPPE PLAUTAMOUR has bequeathed to the city of Geneva 300,000 francs and his estate of Sécheron, which it is expected will be used as a botanic garden.

GOVERNOR BLACK signed, on March 26th, the bill authorizing the establishment of a College of Forestry at Cornell University and appropriating $10,000 therefor. The Trustees of the University are authorized to purchase, with the consent of the State Forest Preserve Board, not more than thirty thousand acres of land in the State park in the Adirondacks for the purpose of establishing the proposed college. The faculty of the college will consist of a professor, two instructors, a forest manager and such rangers, superintendents and other subordinates as may be required. The college will be conducted so as to give instruction and experiment in the latest scientific forestry.

A BILL is before Congress appropriating $25,000 for the purchase of land to be added to the National Zoological Park, Washington, D. C.

THE United States Senate has passed a bill for the protection of song birds, providing that the importation into the United States of birds, feathers or parts of birds for ornamental purposes be prohibited, and prohibiting the transportation or sale of such articles in any Territory of the United States or in the District of Columbia.

THE Prussian Minister of Agriculture, Baron von Hammerstein-Loxten, has issued an official report on the San José scale, setting forth that recently numbers have been found in all stages of development on apples. He adds that it must be presumed that German orchards and nurseries are already infected, and he calls for an immediate and general investigation of the reports and the results.

AT the last meeting of the Council of the Royal College of Physicians, London, a petition was presented from members of the College resident in Italy, asking the support of the Council in protecting their interests as British practitioners in that country in view of the proposed legislation of the Italian Government enacting that qualified medical men of other countries shall not in future be allowed to practice in Italy without holding the degree of an Italian university. It was referred to the President and Vice-Presidents of the College to consider and report thereon.

THERE were 1,259 deaths from the plague during the week ending March 24th.

AT the recent meeting of the Association of

the Chambers of Commerce of the United Kingdom at London a resolution was adopted declaring in favor of the compulsory adoption of the metric system of weights and measures within some limited period of time.

The House Committee on Coinage, Weights and Measures has reported favorably a resolution authorizing the Secretary of the Treasury to make experiments to determine the best materials for minor coinage and to submit new designs for coins to Congress. It is claimed that the copper cent is undesirable, because it is easily corroded and that the five-cent nickel piece is too soft. It is pointed out by the Committee that Switzerland, Austria-Hungary and Italy have adopted pure nickel for their minor coinage with very satisfactory results, the coins being hard, durable and retaining their color, while not corroding.

A first prize of $15, to be known as the Massachusetts Woman's Club Prize, and a second prize of $10 will be awarded to the public school children in the State of Massachusetts who present the best practical studies on the value of our common toad. The prizes will be given by a committee of Clark University on or before November 1, 1898. All essays must be sent in to Professor C. F. Hodge on or before October 1st.

The regulations for the Gedge prize, Cambridge University, founded by a bequest of £1,000 by the late Mr. Joseph Gedge, M.B., of Gonville and Caius College, have been announced. The prize is to be offered for competition in every second year and to consist of the interest on the capital sum. It is to be awarded for the best original observations in physiology or in any branch thereof, that is to say, in histology, physiological chemistry or physiological physics, the word physiology being used in a wide sense. Candidates have to be members of the University who during six terms subsequent to the beginning of the term of their matriculation have studied in the University laboratories or attended University lectures, and who at the time of the award of the prize are of not less than five years' and not more than seven years' standing from matriculation.

Nature quotes from the *Rendiconti del Reale Istituto Lombardo* the conditions of the prizes offered for competition in 1898 and 1899. Most of these prizes are open to all nations; but the essays must be written in Italian, French or Latin, and forwarded under a motto to the Secretary of the Istituto Lombardo, Palazzo di Brera, Milan. The prizes of general interest are the following: (1) The Institute's prize of 1,200 lire for the most complete catalogue of extraordinary meteorological events from the most ancient times down to 1800, excluding auroras and earthquakes, which have already been catalogued. Last date, May 1, 1899. (2) The Cagnola prize of 2,500 lire and a gold medal (value 500 lire) for a critical review of the theory of electric dissociation, with new experiments. Last date, April 30, 1898. (3) The Brambilla prize of 4,000 lire to whoever shall have introduced into Lombardy the most useful new machinery or industrial process. Names to be sent in by April 30, 1898.

The *British Medical Journal* announces that the services of Surgeon-Major Ronald Ross have been placed at the disposal of the Surgeon-General with the Government of India, in order that he may undertake a special inquiry as to the relation of the mosquito to the hæmatozoon of malaria. Surgeon-Major Ross has already done very important work on this subject, and it is not too much to hope that, with the special opportunities which will now be afforded to him, he will be able to clear up the question. Should he be able to establish on a sure basis the theory that the mosquito is the extracorporeal or alternative host of the malaria parasite a great step in advance will have been made. It may not improbably render possible an intelligent prophylaxis against malarial fevers for in no department of human activity is it more true that 'knowledge is power' than in that of preventive medicine.

A joint committee of the Parks and Open Spaces Committee and the Technical Education Board of the London County Council has been considering the practicability of laying out plots of ground in certain of the London parks in such a manner as will afford assistance to scholars at elementary and secondary schools in

the study of practical botany. According to the London *Times*, reports have been presented to the committee on the educational side of the question by Dr. Garnett and Dr. Kimmins. The following suggestions were contained in these reports: 1. That a very valuable experiment could be conducted on a scale sufficiently wide if, in each of three parks, about 20 rods of ground were devoted to the cultivation, for school purposes, of hardy typical plants belonging to 20 natural orders. 2. The beds should be arranged near the paths, one bed being devoted to each order. They should differ in size, the largest being a little under 500 feet square, and the smallest about 100 feet square in area, so that the average of the 20 beds would be approximately one rod. 3. The specimens selected should be such as are suitable for growth, and each should be labelled with its common name and its Latin, or systematic name. 4. Labels giving the names and natural orders should be attached to the more important trees, shrubs and plants throughout the parks selected. 5. A botanical guide to the parks selected should be published under the superintendence of the Technical Education Board and the Parks Committee jointly. 6. Teachers holding printed orders from the Technical Education Board should be able to obtain from the superintendent in each park such specimens as might be required for botanical study in the schools, so far as they could be applied without detriment to the specimens. In a report upon the matter the Parks and Open Spaces Committee adopt these suggestions, and, putting them in the form of recommendations, will shortly submit them to the County Council for approval. They point out that some further suggestions were made, but they thought it would be better in the first instance to deal with the subject quite in the sense of an experiment, and if, later on, it should prove to be resulting advantageously to the schools, possibly the arrangements might be extended to the cultivation of important types of the lower orders of plants, such as fungi, mosses, ferns, etc., and facilities might be afforded for the study of aquatic plants. The chief officer of the Parks Department reported that the proposed arrangements were quite practicable at any of the larger parks, but that some expenditure would be necessary. Upon that point the chief officer has been instructed to submit a report. It is proposed that the experimental beds shall be formed at Battersea-park, Ravenscourt-park and Finsbury-park.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Jacob Tome gives the residue of his estate, estimated at $3,000,000, to the Jacob Tome Institute of Port Deposit, Md., which during his lifetime he had founded and richly endowed.

THE Maryland Senate has passed a bill appropriating $50,000 a year for two years to Johns Hopkins University. It is to be hoped that the bill will be passed by the House, which, as we stated last week, rejected the bill appropriating $100,000 to the University.

HON. CHESTER W. KINGSLEY has given the Worcester Academy $25,000 to complete the sum needed to defray the expenses of the new Kingsley Laboratory, to the dedication of which we referred recently.

IN a letter to the Board of Visitors of the University of Virginia, Charles B. Rouss, of New York, says: "I hereby send you my check for $10,000. Having been informed that the $25,000 previously donated by me was not sufficient to complete the physical laboratory building which bears my name, and being unwilling to permit anyone else to have part in a work which I consider to be my special privilege, I desire so much of the sum sent as may be needed to be used in liquidating the balance due on the cost of the building, the remainder to be added to the equipment fund."

THE Trustees of the Teachers' College, Columbia University, announce the foundation of five fellowships of the value of $500 yearly; and carrying the privilege of free tuition, and ten scholarships of $150 a year, each to be awarded annually; to be tenable for one year, and to be designated respectively as Trustees' Fellowships and Trustees' Scholarships. These fellowships and scholarships will be awarded to applicants who give evidence of special fitness to undertake courses of higher study and original investigation in education. Two new scholarships

for undergraduates are announced, viz., the Charlotte Louisa Williams Scholarship, founded by Mrs. Peter M. Bryson and Miss Grace H. Dodge, which is tenable for one year, yields $150 a year, and is for women, and the Earle Scholarship for men, also awarded annually, and worth $150 a year.

MR. WILLIAM HOULDSWORTH has given the University of Glasgow property yielding an income of £150 a year for a fellowship in physics. *Nature* states that Mr. Houldsworth has taken this method of showing his interest in the welfare of the University and the advancement of science, and his recognition of the distinguished services rendered to scientific research by Lord Kelvin during a professorship of fifty years.

MAGDALEN COLLEGE, Oxford, will award, in October, a fellowship in medical science.

THE seventh summer session of Cornell University will be held from July 5 to August 13, 1898. An announcement of the courses of instruction, just issued, shows that fourteen departments of study will be represented, including mathematics, physics, chemistry, botany and experimental engineering.

ACCORDING to the daily papers Mr. James M. Davis, of St. Louis, has 'bought' Garfield University at Wichita, Kan., and will present it to the Society of Friends.

THE London University Commission Bill has been read for the second time in the House of Lords.

PROFESSOR WILLIAM W. BIRDSALL, now Principal of Friends' Central School of Philadelphia, has been elected President of Swarthmore College, to fill the vacancy made by the resignation of President Charles De Garmo, lately appointed to the position of head of the pedagogical department of Cornell University.

CHANCELLOR C. M. ELLINWOOD, of the Wesleyan University, Lincoln, Neb., has resigned, and Dr. D. W. C. Huntington has been made Chancellor temporarily.

DR. W. J. SIMPSON, late health officer of Calcutta, has been appointed professor of hygiene in King's College, London.

KING'S COLLEGE, Cambridge, has elected to professional fellowships Mr. James Alfred Ewing, M.A., F.R.S., professor of mechanism and applied mechanics, and Mr. A. A. Kanthack, M.A., professor of pathology.

THE professorship of surgery at Cambridge University has been suspended for the present and a reader will be appointed. The lectureship in geography will be made a readership, the Council of the Royal Geographical Society having continued the annual grant of £150 for a term of five years. To this grant the University adds £50.

PROFESSOR BASTIAN has retired from the chair of clinical medicine in University College, London, after a service of twenty years.

MME. MADELEINE LEMAIRE, the flower painter, has been appointed professor of botanical drawing at the Jardin des Plantes, Paris.

DR. K. GROOS, of Giessen, has been appointed professor of philosophy at Basel.

DR. PH. LENARD, assistant professor of physics in the University of Heidelberg, has been called to the chair of physics at Kiel.

DR. A. SAUER, docent in mineralogy, and Dr. Bela Haller, docent in zoology, have been promoted to assistant professorships in the University of Heidelberg.

DISCUSSION AND CORRESPONDENCE.

THE LONGEVITY OF SCIENTIFIC MEN.

IN the *Cosmopolitan Magazine* for March, I quoted from the *Popular Science Monthly* of May, 1884, certain statistics with regard to the longevity of astronomers from Dr. A. B. Lancaster, who derived his data from the records of 1741 astronomers as given in Houzeau and Lancaster's 'Bibliographie générale de l'astronomies.' Lancaster's figures agree, in a general way, with those given by Quetelet in his 'Anthropometrie,' and with those given by Riccardi in his 'Biblioteca mathematica Italiana.' In SCIENCE for March 18th the editor objects to Dr. Lancaster's conclusions and points out what he supposes to be an error of method on Lancaster's part. In fact, his own method is identical with Lancaster's. Their data are quite different, however. The difference in results depends entirely upon the difference of data. Dr. Lancaster assumes that an astronomer 'begins his career,' and deserves

a place on the list, at the age of 18 years. The editor, on the other hand, fixes the age at 40 years. Professor Jastrow in SCIENCE, volume 8, fixes the age in question at 37 years. We have thus three opinions as to the data and, naturally, three results. After examining these three opinions I venture to add a fourth—namely, that the age fixed by Lancaster is too low; that the editor's is much too high and that Professor Jastrow's is somewhat too high. Jastrow's conclusion is: "Men of thought live 69.5 years, or 3.5 years longer than ordinary men, while the lives of men of feeling [poets, musicians, artists, etc.] are three years, those of men of action five years shorter than those of average men." These statements show 'that the kind of psychical and physical activity influences the life period.' Quantitative results in this matter are only to be reached after a critical study of the data. Neither Lancaster nor the editor have made such a study. The assumption of Professor Jastrow is so based, but the details of his processes are not given. I am inclined to think that for astronomers his figures are too low.

EDWARD S. HOLDEN.

MARCH 20, 1898.

TO THE EDITOR OF SCIENCE: In the matter of the longevity of scientific men, I should like to direct the attention of your readers to an article which I published in SCIENCE of October 1, 1886 (reprinted in *Nature* November 4, 1886). I there considered the erroneous conclusions as to the longevity of astronomers and mathematicians, which Professor Holden has recently revived. Inasmuch as I had available in the case of a considerable number of great men the approximate date at which they accomplished work, which would presumably entitle them to a place on this list, I was able to compare more exactly the average longevity of these great men with the average longevity of ordinary men who had reached a similar age. This age I found to be about 37 years, which, with the expectation of life at that age, namely 29 years, would make the age at death 66 years, which was precisely the age at death of the great men selected for this comparison. It is quite possible that men of science live longer than other great men; but, if so, it would, of course, be only a very modest increase of years consistent with the known laws of variation.

JOSEPH JASTROW.

UNIVERSITY OF WISCONSIN,
March 20, 1898.

SCIENTIFIC LITERATURE.

A NEW EDITION OF ECKER'S FROG.*

THERE is probably no single animal, man excepted, which is more studied than the frog. It can be had in quantities; it presents the characters of the vertebrates in a comparatively simple condition, and hence it is used in every zoological course, while the vitality of its tissues renders it of extreme value to the physiologist. Naturally, such a useful animal has been the subject of considerable literature, and outlines of its structure will be found in almost every laboratory manual. Most of these, however, present only outlines, but in 1864 Alexander Ecker, then professor of anatomy in the University of Freiburg, began the publication of what was intended to be an exhaustive account of the anatomy of the common frog of Europe. Ill health, and finally death, prevented his completion of the work, but it was taken up and carried through by Wiedersheim, who succeeded Ecker in the anatomical chair, the final part appearing in 1882. Later (1889) an English edition of the work appeared, but this was more than a translation, for its editor, Dr. George Haslam, left his impress on every chapter, his changes in some instances amounting to a complete revision of certain sections.

Now a new German edition is in process of publication, and it is interesting to note that the new editor, like his predecessors, is connected with the anatomical institute of the University of Freiburg. Professor Gaupp began his studies of the frog in 1892, and since that time most of his publications have related to that animal, its skeleton and its muscles; especially noteworthy

*A. Ecker's und R. Wiedersheim's Anatomie des Frosches auf grund Untersuchung durchaus neu bearbeitet von Dr. Ernst Gaupp. Erste Abtheilung, dritte Auflage. Braunschweig, Vieweg und Sohn. 1896. Pp. x+229. Zweite Abtheilung, erste Hälfte, zweite Auflage. Brunschweig. 1897. Pp. ii+234. 22 Marks.

being his contributions to our knowledge of its cartilaginous skull. Two parts of the new edition have been published so far, one dealing with the skeleton and the muscles, the second with the nervous system.

In dealing with the bony frame-work of the frog one would naturally expect but few changes; since the time of Dugès these parts have been pretty accurately known. In certain places, as in the treatment of the wrist and ankle, the matter in this edition is much changed, while here and there minor changes are noticeable. Thus the name of the anterior end of the sternal structures has been changed from omosternum to episternum, but without (in spite of what appears on pages 31 and 32) sufficient justification. It has yet to be shown that the element in question is homologous with the episternum of Stegocephali, Reptilia, etc. Again we do not like the substitution of 'parabasal' for the well-known term parasphenoid (p. 50), or that of quadrato-maxillaria (p. 55) for the quadrato-jugul. Bardeleben will be pleased with Gaupp's acceptance of the prehallux as a veritable sixth toe.

More noticeable than these points in this section on the skeleton is the space given to the chondrocranium,* a subject which Gaupp has made peculiarly his own. Descriptions are given of these parts in the young and in the adult.

In the section on the muscles the changes are more numerous, names being altered in many instances so as to show more clearly the homologies with the musculature of man. In many places, noticeably with regard to the muscles of the abdomen and of the feet, the changes are more marked, as in these regions Dr. Gaupp has differentiated the muscles to a greater extent than has ever been done before.

The part upon the nervous system, embracing no less than 234 large octavo pages, over half of them in fine print, shows the greatest change. In fact, it is hardly possible to compare this portion of the work in the two editions. This change was certainly to be expected when it is recalled that no discoveries in the last fifteen years equal those in relation to the structure of the brain and nerves. The Golgi and methylene blue methods have let no little light into this most complicated part of vertebrate anatomy.

Dr. Gaupp adopts throughout the neural terminology of the German Anatomical Society, which, backed as it is by some of the best anatomists of the world, will probably have wide acceptance, although some of its features seem needless. Dr. Gaupp has given us not only an account of those features in the nervous system which can be made out by ordinary dissecting methods, but one of the clearest summaries of the internal structures with which we are acquainted. The student who has been troubled in trying to understand the complicated relations of fibre-tracts, ganglia, 'nuclei,' fasciculi, commissures, deeper origin of cranial nerves and other like questions should follow through the matter detailed in these pages, where he will find summed up not only the studies of Burckhardt, Edinger, Köppen, Ramón y Cajal, Sala, Studnička, etc., but the investigations of the author himself. The peripheral and sympathetic systems are treated with equal thoroughness and their distribution traced with a detail far beyond that in any previous work on the frog; and the chief point on which we could desire more information not given in this work is a study of the nerve components such as Dr. Strong has given us for the tadpole. On almost every page we find a feature lacking in the previous editions—comments on the morphological bearings of the facts presented. Where there is so much and where all is so well treated it is difficult to select any one part for special mention. We can hardly hope that the whole work will be translated into English, but we wish that these pages on the nervous system could be put into available shape for the American student, for they form a most admirable introduction to neurological studies, and for many years no work upon the nervous system of the Ichthyopsida can be undertaken without extended use of Dr. Gaupp's summary.

In its mechanical make-up the work is attractive. The typography is good and the subordi-

*Gaupp, like most Germans, calls this the primordial cranium. It is better to restrict this term to the membranous envelope of the brain which precedes the cartilaginous skull.

nation of headlines, etc., is consistent throughout. The illustrations have been largely redrawn, and the frequent use of color in them render them more intelligible. Why is it that American publishers insist in using a thick and heavy paper in their publications? Certainly thin paper like this (the 460 pages are but three-quarters of an inch in thickness) has numerous advantages. A final word, which may interest some, is that the German is clear and simple and does not require extensive linguistic attainments and capacity for unravelling involved sentences for its perfect comprehension. The section on the circulatory system is promised for this year. We await its appearance with the highest anticipations.

J. S. KINGSLEY.

A Laboratory Manual in Practical Botany. By CHARLES H. CLARK, A.M., D. Sc., Principal of Windsor High School. New York, American Book Company. 1898. Small 8vo. Pp. 271.

It is significant of the change which has come over the teaching of elementary botany in this country that the publishing house which has for many years issued the text-books which perpetuated the old method of presenting the subject has at length found it desirable to bring out a book written along modern lines. The author has been known for some time as the writer of a handy book of practical methods in microscopy, but has not been known as a worker in botany. He has adopted that laboratory method which has commended itself to many teachers—namely, of first presenting a summary statement including the principal features of the plant in hand, and following it by a series of 'practical studies' in which the pupil is not told too much, but is led to make independent observations.

After a rather long and quite needless preliminary chapter there follow chapters on 'Slime Molds' (Myxomycetes), Diatoms, Fission Plants, Algæ, Fungi, Bryophytes, Pteridophytes and 'Spermaphytes.' The general sequence is therefore quite good, since it is in accord with that usually adopted in modern works. In a general way, we may say that the presentation is good, also, the plants selected as examples being those commonly regarded as fairly representing the larger groups. It is unfortunate, therefore, that in the compilation of this book the author could not have had the aid of a botanist well acquainted with the various groups of plants treated. The failure to do this has led to many errors of statement, doubtless due to a misunderstanding of the subject in the labor of compiling from various texts.

In order that this book may be a safe guide, there are numerous errors and slips which will need correction. When we add to the direct errors a looseness of statement which too often mars the pages we have ample reason for asking for a revision before too much harm has been done. Thus it is inexcusable to call the ear of corn with its husks a fruit (p. 30), and to say that Spirogyra is one-celled, the cells being held together by a gelatinous coating (p. 41). We all once said that the Siphoneæ were one-celled, as the author still does (p. 72), but we know better now, and the same may be said regarding the fusion of the 'sporidia' of Ustilagineæ (p. 122), not now regarded as a sexual act. So, too, it is an error to say that stomata first appear in Pteridophytes (p. 184), good ones occurring on the moss sporophytes, and that the macrospores of Spermatophytes are borne in embryo-sacs (p. 205). The directions for the sectioning of the youngest pine cone (p. 209) are radically wrong, since at this time there is neither 'embryo-sac' nor 'endosperm' present, while fertilization does not occur until a year later.

A few examples of loose and inexact statement will suffice to show how seriously the book offends in this direction. Thus, on pp. 9, 10, "Another fact which distinguishes the Thallophytes is that the female gamete is never an archegonium, while in all other groups it is essentially an archegonium;" p. 12, "The terms *group*, *branch*, *class*, *order* and *family* are variously and arbitrarily used by writers;" also (p. 40), "different varieties may be found," where the author means 'different species;' still, again (p. 79), 'is the best known plant of its *class*,' here evidently intended to refer to its *order* or *family*. There is no excuse for a description of a fern prothallium as 'a small thalloid leaf' (p. 185), nor for the description

of gymnosperms (p. 206), which is based entirely upon the structure of the pines alone.

A few blunders of another kind mar the book, as 'protonemæ' (p. 10 et seq.), 'barbarous Latin and Greek names' (p. 8), 'female macrospores and male microspores' (p. 186), 'botanies' (p. 208). It is quite unpleasant also to see chlorophyl for chlorophyll and spermaphytes for spermatophytes.

There are many excellent features about this book, and both author and publishers owe it to themselves to see that the grave defects of the kind indicated above are speedily corrected.

CHARLES E. BESSEY.

Elementary Botany. By PERCY GROOM, M. A. (Cantab. et Oxon.) F. L. S. London, Geo. Bell & Sons. 1898. With 275 illustrations.

This concise and attractive volume of 252 pages is designed by the author to meet the requirements of secondary schools in England. As suggested in the preface, "though by no means a 'cram-book' for elementary examinations, a thorough knowledge of the contents of this book will enable a candidate to pass with distinction." Perhaps such a sentence will indicate a certain difference in educational conditions between England and America, for here it would not be easy to select any two hundred and fifty pages of botanical exposition and guarantee, upon its proper assimilation, a 'pass with honor.' The reason probably lies in the greater conservatism of the English school curriculum and the firm adherence of the English teacher of botany to the traditions of earlier days, when the systematic study of flowering plants filled a larger horizon than it does at present. When one understands the clientèle for which Groom's Elementary Botany was written it must be acknowledged to be an extremely good book. It is clear, crisp, accurate, not technical enough to be dry, nor untechnical to the point of looseness. It comprises in astonishingly small compass an adequate account of general organography, metaspermic taxonomy and elementary physiology. The figures, many of them original, are nearly all distinctly good and are far above the average of those presented in most books of similar purpose. The original figures are some of them real additions to botanical iconography, as, for example, figs. 49–52, illustrating the yearly history of the common crocus.

One is impressed by the thorough modernness of the writer of this little text-book in many small bits of detail scattered through the work, some of which might easily escape the reader. The definition and classification of fruits, the account of floral morphology and even the definition of the flower are suggestive. The reviewer has always insisted upon the necessity of the most careful definition and can conscientiously congratulate Mr. Percy Groom on his success in one or two difficult points. Sometimes, however, there is a little vagueness. It would, perhaps, be too much like trifling to call attention to a sentence on the first page—"A fern seems very unlike a mushroom and yet both are alike in that neither of them possesses flowers." This seemed to suggest an old riddle—"Why is a horse like an oyster?"—to which the very obvious answer is, "Because neither can climb a tree." Such absurd collocation of ideas would naturally not occur to the English users of this work, and the author cannot be blamed for not protecting himself against manifestations of a well-known American failing.

Some reviewers will doubtless object to the multiplicity of definitions in the Elementary Botany, but in so doing will scarcely do more than indicate their ignorance of the English school system. Where examination has been reduced to a science, as in England, and where secondary education has so thoroughly crystallized in well-marked grooves, this type of text has a place of its own and in the belief of the reviewer fills it admirably.

CONWAY MACMILLAN.

An Introductory Course in Quantitative Chemical Analysis. By PERCY NORTON EVANS, PH.D., Associate Professor of Chemistry, Purdue University. Ginn & Company. 1897.

The number of guides or manuals to qualitative analysis is very great, as nearly every teacher of that subject publishes a book arranged according to his ideas, although the material is practically identical. The field of quantitative analysis has not been so well covered. The student is generally directed to

make certain analyses, and is referred to one of the large text-books for details. A beginner is bewildered by the complexity of the work, and ends by becoming a mechanical agent, following detailed directions without knowing or inquiring why certain courses of procedure are necessary. The author has arranged a course which will serve as an introduction to the subject and give the student an excellent working basis for more advanced work in this line. He has selected typical methods in both gravimetric and volumetric analyses. In a section devoted to miscellaneous analyses he gives general directions for the analysis of such things as silver coins and rocks, and refers the student to larger works for details. The directions are clear and logical, and the reactions which take place in each case are given; but the author has purposely omitted some details, as methods of filtering and other manipulations, as he considers that these should be learned by the student from demonstration by the instructor. This book will no doubt prove valuable to those beginning work of this kind, and especially for those who are desirous of obtaining a general idea of the methods used in quantitative analytical work.

J. E. G.

A Laboratory Guide to the Study of Qualitative Analysis. By E. H. S. BAILEY, PH.D., Professor of Chemistry in the University of Kansas. Hudson-Kimberly Publishing Company. 1896.

The author states in his preface that he cannot hope to offer anything especially new or original, but his aim has been to present the subject in as concise a form as possible. The general arrangement is similar to that of many other works on this subject, and the author acknowledges the assistance he received from them. Each group is studied in detail, the principal soluble and insoluble compounds being described and the methods given for the separation of the members of the group.

J. E. G.

Repetitorium der Chemie, mit besonderer Berücksichtigung der für die Medizin wichtigen Verbindungen, sowie des 'Arzneibuches für das Deutsche Reich' und anderer Pharmakopöen, namentlich zum Gebrauche für Mediziner und Pharmazenten. Bearbeitit von CARL ARNOLD, Professor der Chemie an der Königlichen Tierärztlichen Hochschule zu Hannover. Achte verbesserte und ergäntze Auflage. Hamburg und Leipzig, Verlag von Leopold Voss. 1898.

The author, in his preface, says that this book is chiefly intended to prepare medical students for the government examination in chemistry. The first edition was published in 1884. Eight editions in thirteen years seem to indicate that the book fulfills its purpose. A careful examination fails to show why it is popular. The crude facts of methods of preparation of chemical substances, and the properties of the elements and compounds, are carefully separated from the chemistry which would make these facts intelligible and interesting. Under the title 'Allgemeine Chemie' the author gives forty-two pages of bald, concise statement. He gives in the next 230 pages dry facts concerning elements and inorganic compounds, with scarcely an illustration or illuminating thought. The last and longest section, 275 pages, is devoted to organic chemistry; the nature of the subject compels the author to treat it more intelligibly than the inorganic part, but light is admitted sparingly and under protest.

It is only fair to say that as a compend of facts the book is both full and concise. The student who could memorize it all, with some explanation from a competent coach, would have a mass of information which would be of excellent service to him when he should begin the study of chemistry.

The popularity of this book suggests speculation as to the nature of the German government chemical examination for medical students. To the lay mind it would seem that when with at least one well-known and excellent Repetitorium—Pinner's—written for the same purpose, for sale everywhere in Germany, this present compilation finds favor, the government examiners must demand crude statements of facts—not chemistry. Many of the well-known English quiz compends on chemistry are just as heavy and wooden; but we know that the universal cramming for government examinations in England is nowhere more condemned and deplored than by English chem-

ists, who refer to the study of chemistry in Germany as the model to be copied.

It would be an interesting occupation for a retired chemist, of statistical mind, to make a collection of government chemical examination papers in all countries, and of the compends used in cramming for the examinations; then to see whether the dryness of the systems is local or general. E. Renouf.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON—289TH MEETING, MARCH 12.

Dr. C. W. Stiles presented some 'Practical Suggestions in Regard to Trichinosis,' briefly reviewing the methods of pork inspection in vogue in Germany.

Dr. Erwin F. Smith spoke on 'Migula's System der Bakterien,' stating that Migula was the first to classify bacteria on morphological instead of physiological characters. He briefly outlined the groups and genera adopted, giving the characters on which they were based.

Dr. F. C. Kenyon, under the title 'Some Recent Advances in our Knowledge of the Nervous System,' briefly reviewed the general structure of the nervous system of arthropods. The fact was brought out that the so-called nerve cell is situated on the outside of the system, thus resulting in the formation of a nerve element comparable with the spinal ganglia of mammals. This so-called nerve cell was given the name of cytosomite, and the process leading from it into the nervous system was denominated the caulite, the remaining portions of the element being considered as neurite and dendrite. The distinctions between these was based upon function and the nerve element compared to a Leyden jar, of which the neurite was held to be the recipient part, and the dendrite the discharging part, for all neural impulses. In the case of the dendrite, however, this distinction may be faulty, since dendrites occur whose relations seem to indicate that they must function both as recipient and discharging parts. It was thought that the arthropod cytosomite and caulite do not function in the transfer of neural impulses, since they lie to one side of what seems to be the most direct route. The neurocyte, or nerve element, was briefly defined and the different types of neurocytes to be found in the nervous system of arthropods briefly described and commented on. The paper will be published in full later on. F. A. Lucas,

Secretary.

AMERICAN CHEMICAL SOCIETY, JANUARY 13.

The fourth annual meeting of the Washington Section of the American Chemical Society was held on January 13th. The following officers were elected for the ensuing year: H. N. Stokes, President; Peter Fireman and H. Carrington Bolton, Vice-Presidents; William H. Krug, Secretary; W. P. Cutter, Treasurer, and C. E. Munroe, E. A. de Schweinitz, Wirt Tassin and W. F. Hillebrand, additional members of the Executive Committee.

The regular February meeting was held on Thursday evening, February 10th. Mr. Tassin presented a paper on 'The Origin of Crystals and Crystalline Growth,' which contained a *résumé* of theories concerning the origin of crystals and the processes of crystal-growth, and consisted of a discussion of the results of the researches of Vogelsang, Behrens, Knop, Sadebeck and Lehmann.

Dr. H. Carrington Bolton read a paper entitled 'Iatro-Chemistry in 1897,' which was published in full in last week's issue of Science.

Dr. H. W. Wiley addressed the Society on the subject of pure food legislation, and discussed the benefits which would undoubtedly result from the deliberations of the Pure Food Congress, which will assemble in Washington on March 2d. William H. Krug,

Secretary.

NEW BOOKS.

Quantitative Chemical Analysis by Electrolysis. Alexander Classen, in cooperation with Dr. Walter Löb; authorized translation by W. H. Herrick and B. B. Boltwood. New York, John Wiley & Sons; London, Chapman & Hall. 1898. Pp. 301. $3.00.

Reform of Chemical and Physical Calculations. C. J. T. Hanssen. London and New York, Spon & Chamberlain. 1897. Pp. 72.

Einfühlung und Association in der neueren Aesthetik. Paul Stern. Hamburg und Leipzig, Leopold Voss. 1898. Pp. viii+81. M. 2.